

REMEDIAL ACTION WORK PLAN

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Willow Brook and Willow Brook Pond

November 2000

PREPARED FOR:

United Technologies Corporation
Pratt & Whitney
400 Main Street
East Hartford, CT 06018

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Comm. No.88UT002

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1.0 INTRODUCTION

1.1 General

This Remedial Action Work Plan (RAWP) has been developed to present the approach and strategy for the remediation of Polychlorinated Biphenyl (PCB) contaminated sediment within Willow Brook and Willow Brook Pond at the United Technologies Corporation (UTC), Pratt & Whitney (P&W) manufacturing facility in East Hartford, Connecticut (Site). A Site Location Map is included as Figure 1-1. The remediation approach consists of the excavation and offsite disposal of soil and sediment from within and immediately surrounding Willow Brook and Willow Brook Pond that contains PCBs at concentrations greater than 25 milligram per kilogram (mg/kg or parts per million (ppm)). Following excavation, a geotextile, soil and rock cap will be installed over the entirety of Willow Brook Pond and the open channel of Willow Brook from Willow Brook Pond to Main Street. The exception to this approach is the wetland downgradient of the dam where excavation of PCBs at concentrations greater than 1 ppm will be performed and the area backfilled and planted to restore the wetland. Following remediation, Willow Brook Pond and the open channel of Willow Brook from the pond to Main Street will be restored to the current configuration.

As discussed subsequently in this section, semi-volatile organic compounds, petroleum hydrocarbons and select metals were also detected in soil and sediment within and immediately surrounding Willow Brook and Willow Brook Pond. These constituents are commingled with soil and sediment containing PCBs. These constituents will remain in place in those areas in which they are commingled with soil and sediment containing less than 25 ppm PCBs and will be rendered inaccessible with the geotextile, soil and stone cap.

In summary, the component of the remediation approach include:

- The excavation and offsite disposal of approximately 8,500 cubic yards of soil and sediment containing PCBs at concentrations greater than 25 ppm from within and immediately surrounding Willow Brook and Willow Brook Pond;
- The excavation and offsite disposal of approximately 1,500 cubic yards of soil and sediment containing PCBs at concentrations between 1 and 25 ppm from within and immediately surrounding the wetland area located north of Willow Brook;
- The excavation and offsite disposal of approximately 2,500 cubic yards of soil and sediment from within the open channel of Willow Brook to allow for the installation of the geotextile, soil, and stone cap within the stream channel;
- The demolition and offsite disposal of the existing Process Water Facility;
- The removal and offsite disposal of an oil/water separator and the excavation and offsite disposal of impacted soil in the vicinity of the oil/water separator and the placement of an engineered control to achieve compliance with the requirements of the RSR;
- The placement of a geotextile, soil and stone cap over the entirety of the excavated area (except an approximately 1-acre wetland are described below) to isolate sediment containing less than 25 ppm total PCBs commingled with semi-volatile organic compounds, petroleum hydrocarbons, and select metals;
- The restoration of an approximately 1-acre wetland located downstream of the Willow Brook Pond Dam; and
- The implementation of two institutional controls consisting of 1) a deed restriction to ensure the affected area will not be used for residential purposes and to prohibit excavation; and 2) installation of a fence around the entire area to preclude access to Willow Brook and Willow Brook Pond.

1.2 Background Information

The UTC/P&W facility is located at 400 Main Street in East Hartford, Connecticut, and is approximately 1,100 acres in size. P&W initiated aircraft engine manufacturing operations in East Hartford in December 1929. Current site operations are conducted in a 6.5 million square foot complex and include administration and management, manufacturing, testing, research and development and ancillary services. All of these activities take place in the western portion of the 1,100-acre property. The Rentschler Airport and the Klondike Area occupy the eastern portion of the property. P&W previously used these two areas as an airport and a storage/testing area, respectively.

The Willow Brook and the Willow Brook Pond remediation area is about 4 acres in size. The site is within a mixed residential, commercial, and industrial area of East Hartford, Connecticut. Property usage in the vicinity of the proposed RA area includes the following:

- UTC/P&W parking facilities and the Rentschler Airport, to the east;
- Apartment complex and residential areas to the north;
- A commercial business, parking facilities, and UTC/P&W manufacturing to the south; and
- Predominantly commercial areas with some residential to the west (across Main Street).

1.2.1 Site Description

Willow Brook is a small stream transecting the UTC/P&W facility from the northern portion of the Rentschler Airport through to the northwest portion of the current UTC/P&W operations complex. Willow Brook flows in a southwesterly direction in an open channel from the Rentschler Airport, is then hard-piped underground to the inlet of Willow Brook Pond, and continues from the pond as an open channel to a culvert under Main Street. From Main Street, Willow Brook flows in an open channel for a distance of approximately 2,500 feet to the confluence with the Connecticut River (see Figure 1-1). Willow Brook Pond is a man made water body located in the northern portion of the Site (See Figure 1-2). The pond, a single body of water when first created, has been modified various times through the years. It is now comprised of two ponds subdivided by a culvert. Historically, basement dewatering, industrial waters and process wastewater were directed to the pond. Some of these discharges were routed through an oil/water separator. Currently, Willow Brook Pond serves as part of the non-contact cooling water re-circulation system serving the Site.

During routine draining of Willow Brook Pond in September 1997, an oil sheen was noticed seeping through the sediment. P&W reported the sheen to the United States Coast Guard and the CTDEP in accordance with discharge reporting requirements. Following the detection of PCBs in a sample, the CTDEP issued P&W a NOV, No. PCB 97-08, on November 7, 1997. In response to the NOV, UTC/P&W developed a sampling work plan and conducted three phases of remedial investigation from December 1997 to April 1999. These investigations identified the probable sources and provided the analytical data to sufficiently define the horizontal and vertical limits of contamination allowing development of a remediation plan.

1.2.2 Physical Setting

Physiography

The UTC/P&W East Hartford facility lies within the Central Lowland province of Connecticut, a north-south trending valley system, which is approximately 20 miles wide at East Hartford. The valley system consists of a series of parallel valleys separated by linear north-south trending ridges. The Connecticut River flows southward just west of the site and drains the northern part of the valley system, ultimately

discharging to Long Island Sound. The Connecticut River Valley, which is 5 to 6 miles wide and flat (local relief on the order of 30 feet), has created a broad floodplain and eroded terraces in the flatter portion of the valley system. The central portion of the Connecticut River Valley was occupied during deglaciation of the area by a large glacial lake. This lake, known as Glacial Lake Hitchcock, was formed during the northward retreat of the last continental ice sheet and existed about ten thousand years ago.

A regional drainage divide between the Connecticut River Basin and Hockanum Regional Basin lies to the north of the site and approximately 3 miles to the east of the site. The Hockanum River is a tributary of the Connecticut River.

Surface Water

From a review of the "Water Quality Classifications Map of Connecticut," published in 1987 by the CTDEP, surface water quality in Willow Brook has been designated as "B" along its entire reach to the confluence with the Connecticut River. As noted, the Willow Brook/Connecticut River confluence is approximately 2,500 feet from the Main Street culvert. The "B" designation indicates Willow Brook is known or presumed to meet water quality criteria for recreational use, fish and wildlife habitat, agricultural and industrial supply, and navigation. The Connecticut River has been designated "SC/SB." This designation indicates that the water quality in the river does not presently meet class "SB" water quality criteria for one or more designated uses, but the goal is to meet class "SB" criteria. Designated uses for class "SB" include potential for certain fish and wildlife habitat, recreational boating, industrial supply, and other legitimate uses including navigation.

Storm water

Surface water drainage in the immediate vicinity of Willow Brook and Willow Brook Pond is predominantly overland sheet flow. Storm water in the adjacent plant area is handled by a number of catch basins, roof drainage systems, and storm drain pipelines, which discharge directly into Willow Brook or through an oil/water separator prior to discharge to Willow Brook. The Flood Insurance Rate Map, prepared by the Federal Emergency Management Agency and dated October 23, 1981, for East Hartford, Connecticut (Community No. 090026 0003-D Panel 3 of 4), shows the projected 100-year floodplain of the Willow Brook area. Most of the flood-prone areas depicted along Willow Brook lie between the 100-year to 500-year floodplain.

Meteorology

The climate of central Connecticut is a cool, humid, modified oceanic type. Winters are long and moderately cool; summers are short and mild. The mean annual temperature is approximately 50 degrees Fahrenheit (°F), ranging from an average of approximately 28°F in January to an average of 73°F in July. The average annual precipitation of approximately 44 inches is fairly evenly distributed throughout the year (National Oceanic and Atmospheric Administration, 1990); snowfall is about 40 inches per year (Soil Conservation Service, 1962). The prevailing wind is from the south or southwest in spring and summer and from the north or northwest the rest of the year.

1.2.3 Regional and Site Geology

Regional Geology

The geology of the region consists of sedimentary and igneous bedrock overlain by unconsolidated sediments. The UTC/P&W East Hartford facility is situated in the central portion of the Hartford Basin

of the Newark Terrain. The rocks of the Hartford Basin were originally deposited as sediments or as the result of volcanic activity in a rift valley setting. The bedrock stratigraphy consists of four terrigenous sedimentary rock formations: the New Haven, Shuttle Meadow, East Berlin, and Portland. These units are composed of interlayered reddish siltstones, sandstones, and conglomerates. The sedimentary formations are separated from each other by three laterally continuous basalt units: Talcott, Holyoke, and Hampden Basalts. The bedrock layers dip gently eastward and are crosscut by numerous steep faults.

The unconsolidated sediments in much of the region can be divided into three major units: glacial till and limited deposits of stratified sand and gravel, glaciolacustrine deposits, and post-glacial fluvial deposits. These three units were deposited in this order, with the till and the limited stratified sand and gravel deposits generally lying directly over bedrock.

The till is poorly sorted and varies widely from a non-compact mixture of sand, silt, gravel, and cobbles with trace amounts of clay to a compact mixture of silt and clay with some sand, gravel and cobbles. The till is typically less than 10 feet thick in the vicinity of the UTC/P&W facility. The stratified sandy sediments (stratified drift) are much less extensive than the till and usually consist of sand, gravel and silt deposited by melt water in contact with or in front of the glacier. These sediments appeared to be of limited extent and occurred in relatively thin layers (less than 10 feet) beneath the UTC/P&W facility.

Glaciolacustrine deposits include both lake-bottom sediments consisting of silt and clay and sand and gravel deposits formed by beaches and deltas in the lake. Thicknesses of lacustrine clays and silts as great as 270 feet have been reported beneath the UTC/P&W facility. These deposits are thickest in areas of deep bedrock valleys, one of which trends north-south and underlies the Main Plant Area. In a few isolated cases, thin layers of gravelly sands have been documented within the deeper portion of the glaciolacustrine unit.

Post-glacial fluvial sediments generally consist of sand and gravel deposited as the Connecticut River flowed across the exposed lake bed and cut stream terraces into the exposed lacustrine clays and silts, creating stream terrace deposits. These deposits are laterally extensive over the UTC/P&W facility, and are typically 15 to 30 feet thick across the facility.

Site Geology

Bedrock beneath the UTC/P&W facility consists of red sandstone and siltstone of the Portland Formation. Depth to bedrock within the facility boundaries is over 300 feet in the Main Plant Area, and approximately 30 feet along the eastern property boundary. Near the western property boundary along the Connecticut River, depth to bedrock is about 150 feet. A north-south trending, buried bedrock valley underlies the UTC/P&W facility; this buried valley may have been a pre-glacial channel of an ancient river following a similar course to that of the Connecticut River.

A thin layer of glacial till, up to 10 feet thick, typically directly overlies bedrock. A gravelly sand stratified drift deposit has been reported above or in place of the till in a few isolated instances.

Glaciolacustrine lake bottom sediments occur over most of the UTC/P&W facility, and range in thickness from 9 to 270 feet. These deposits thicken towards the central part of the facility (near the Main Plant Area) and are generally absent near the eastern boundary of the site.

The deposits consist of laminated (varved) silts and clays with red fine sand partings. The color varies from gray near the surface to red at the base of the unit. The presence of local sand or gravel lenses

within the glaciolacustrine unit near its base has also been reported, but these are not assumed to be laterally extensive.

Beneath the eastern portion of the site, the contact between the silt and clay and overlying sediments is distinct. However, in the Main Plant Area, an intermediate layer of fine sand and silt that varies in thickness from approximately 5 to 20 feet occurs between these two deposits. A similar zone may occur at the base of the glaciolacustrine unit as well; these zones are typical of depositional facies changes that are characteristic of the depositional environment (glaciolacustrine).

Post-glacial fluvial deposits on the UTC/P&W facility are floodplain sediments of the Connecticut River. As the river cuts a channel through the floodplain, terraces were formed along the banks. The stream terrace deposits occur across the facility and generally range from 15 to 30 feet in thickness. These deposits increase in thickness toward the central part of the facility where greater erosion of the top of the glaciolacustrine silt and clay may have occurred along a former (perhaps earlier post-glacial), abandoned channel of the Connecticut River. These deposits generally consist of uniform brown fine, or fine-to-medium, sand. More recently deposited laminated silt and sand (alluvium) occurs near the western boundary of the site. This alluvium is thickest near the Connecticut River and likely interfingers with the older stream terrace deposits. Other recent alluvial deposits are found scattered across the facility near existing and former streams or wetland areas.

1.3 Summary of Previous Investigations

This section presents a summary of the three previous phases of investigation conducted at Willow Brook and Willow Brook Pond from December 1997 to April 1999. A summary of the analytical results for the entire sampling program is included as Appendix A in a series of detailed site plans developed by LEA during the remedial investigation.

The investigations identified some probable sources and provided the analytical data to define the horizontal and vertical limits of contamination in sufficient detail to allow for the development of a remediation plan. Figures 1-3 and 1-4 present an overview of the delineation of the extent of PCBs in soil and sediment within and immediately surrounding Willow Brook and Willow Brook Pond.

Phase I: *Report on PCB Investigation for Willow Brook and Willow Brook Pond Sediment*, prepared by LEA, dated February 13, 1998. The purpose of this report was to present the findings of the PCB investigation conducted on Willow Brook and Willow Brook Pond sediment in order to address the requirements of item (1) of the third paragraph of the NOV, No. PCB 97-08 issued by the CTDEP and dated November 7, 1997. The sampling was performed in accordance with the *Work Plan for Willow Brook and Willow Brook Pond PCB Investigation*, prepared by LEA and dated December 12, 1997, and approved by the CTDEP on December 22, 1997.

The report describes the field activities performed based on a predetermined sampling grid and presents the analytical results of the investigations. A Toxic Substances Control Act (TSCA) sampling grid was developed to specify the number and location of samples for the investigation in accordance with USEPA's guidance document "*Field Manual for Grid Sampling of PCB Spill Sites to Verify Cleanup*". Two separate sampling grids were prepared for the east and west surface water bodies of Willow Brook Pond. The sampling was performed in accordance with the approved Work Plan, with the exception that the pond was not drained in response to CTDEP's concerns about sediment disturbance. Detectable PCB values on the sediment samples collected ranged up to a maximum concentration of 617 ppm total PCBs at sampling point WT-SD-33, located immediately downgradient of the subsurface connector between the eastern and western surface water bodies comprising Willow Brook Pond. Relatively high PCB

concentrations were also observed in sediment samples collected in the vicinity of this location in both water bodies. Relatively elevated PCB concentrations were also observed along Willow Brook immediately downstream of Willow Brook Pond. A total PCB concentration of 327.4 ppm was observed in the sediment at location WT-SD-54. The results of the investigations indicated the presence of elevated PCB concentrations throughout Willow Brook Pond and in the section of Willow Brook between the pond and Main Street. The PCB concentrations observed beyond that point were below 1 ppm.

Selected sediment samples were also analyzed for volatile organic compounds (VOCs), semi volatile organic compounds (SVOCs), total petroleum hydrocarbons (TPH), and the RCRA eight metals (arsenic, barium, cadmium, chromium, mercury, lead, silver, selenium) plus nickel, zinc.

Among the limited sediment samples analyzed for these parameters, elevated levels of SVOCs were detected in the sediment at location WT-SD-47 in the eastern water body of Willow Pond. Some of the highest SVOC concentrations reported in that sample included pyrene (480 mg/kg), phenanthrene (514 mg/kg), fluoranthene (537 mg/kg), chrysene (232 mg/kg), etc. Some of the highest metal concentrations observed in this location included lead (153 mg/kg), zinc (152 mg/kg), barium (37.7 mg/kg), and nickel (36.4 mg/kg), etc. The only VOC compounds identified in this location included trichloroethylene (23 µg/kg), tetrachloroethylene (11.6 µg/kg), 1,1,1-trichloroethane (9.7 µg/kg), and 1,1-dichloroethane (10 µg/kg). Generally lower SVOC and VOC concentrations were observed in the other locations samples.

Elevated TPH concentrations were observed at WT-SD-47 (1,160 mg/kg) and WT-SD-09 (4,340 mg/kg and 3,940 mg/kg in the duplicate). Relatively elevated metal concentrations were also observed at this location (zinc 772 mg/kg and 689 mg/kg in the duplicate, nickel 595 mg/kg and 593 mg/kg in the duplicate, lead 714 mg/kg and 691 mg/kg in the duplicate, chromium 490 mg/kg and 497 mg/kg in the duplicate).

It should be noted that no sediment was encountered in upstream accessible locations along the Willow Brook conduit to allow sample collection. Several manholes along the subsurface conduit were opened to confirm no sediment had accumulated within the conduit. Historical measurements have indicated non-detectable PCB levels in sediment samples collected from upstream brook locations, prior to the conduit.

Based on the results obtained, additional investigations were determined to be necessary to better characterize the vertical extent of the contamination within Willow Brook and Willow Brook Pond and to identify potential nearby sources of contamination.

Phase II: *Report on Supplemental PCB Investigation for Willow Brook and Willow Brook Pond*, prepared by LEA, dated April 1998. The purpose of this report was to present the findings of the supplemental PCB investigation conducted on Willow Brook and Willow Brook Pond. The supplemental soil and sediment sampling was performed to identify potential nearby sources of contamination and to provide information of the vertical extent of the contamination within Willow Brook and Willow Brook Pond. An overview of the investigation of the potential source areas and the delineation of Willow Brook and Willow Brook Pond sediments is as follows:

Southwestern bank of Willow Brook Pond: This area was investigated to determine if infiltration or seepage from historic sludge drying beds located to the south of Willow Brook Pond was a potential source. Four soil borings were also installed at the southwestern bank of Willow Brook Pond downgradient of the historic sludge drying beds. The borings were advanced to a depth of 20 to 24 feet from the western bank of the pond. Low total PCB concentrations (up to about 2 ppm) were detected in the borings installed along the southwestern bank of Willow Brook Pond. These concentrations did not appear to be indicative of a source of PCB contamination.

Area of Former Oil Basin area, within the western section of Willow Brook Pond: This area was investigated to determine if infiltration or seepage from historic operations in the Pond area was a potential source. The existing oil-water separator is currently operating in this area. Four soil borings were installed in the vicinity of the area of Former Oil Basin. Two of these borings were installed on top of the bank immediately to the south of the area of Former Oil Basin using a Geoprobe® and advanced to a depth of 20 to 24 feet. The other two were installed by hand to a depth of 2 to 8 feet in the immediate proximity of the existing oil/water separator. PCBs were detected in the soils collected from the four soil borings; however, the highest total PCB concentrations were of the order of 1.3 ppm. These concentrations do not appear to be indicative of a source of contamination.

Former Oil-Water Separator, located historically in the area between the two sections of Willow Brook Pond: This area was investigated to determine if infiltration or seepage from historic operations in the Pond area was a potential source. Five soil borings were installed in the vicinity of the Former Oil-Water Separator in between the two sections of Willow Brook Pond to identify potential historic sources of PCB contamination. The soil borings were installed using a Geoprobe® to a depth of approximately 20 feet. Soil samples were collected every 2 feet and screened visually for the presence of oil. Three samples were submitted for analysis from each boring. Elevated total PCB concentrations were observed in the soil samples from this location. The total PCB concentration observed in this area ranged up to 128 ppm (location WT-SB-88) at a depth of 10 to 12 feet. Free oil was also observed in this location. The highest PCB concentrations were observed at a depth of approximately 8 to 12 feet below ground surface corresponding approximately to the depth of the water and sediment within the pond, and the approximate level of the water table in the area. These concentrations and findings from this area are indicative of a probable source. It should be noted that the contamination might have originated from multiple sources.

Sediment Sampling: In-depth sampling was also performed within the eastern and western water body of Willow Brook Pond, and along Willow Brook in the vicinity of the wetlands area, and in the wetland area within UTC/P&W's property. These samples were collected to develop at-depth profiling information. It should be noted that only surface sediment samples were collected during the initial Phase I investigation. A 5-foot core was used for collection of the sediment and underlying soil samples during Phase II. Generally, one sediment and two soil samples of the underlying soil were selected from each sampling location. Detected total PCB concentrations within the two sections of Willow Brook Pond (east and west) ranged in concentrations up to 258 ppm in the upper 0- to 2-foot interval. The highest concentration was observed in location WT-SD-72 near the pond's effluent point. Approximately 73.5 ppm of total PCBs were detected at a depth interval of 2 to 4 feet in location WT-SD-78, located at the eastern portion of Willow Brook Pond. Significantly lower and/or non-detectable levels were observed at greater depths. PCB concentrations remained at detectable levels at certain locations at depths up to 8 or 12 feet. Total organic carbon (TOC) concentrations up to 162,000 mg/kg were detected in sediment samples within Willow Brook Pond (location WT-SD-75 at a depth of 0 to 2 feet).

The total PCB concentrations detected in Willow Brook in the vicinity of the wetlands area and within the wetlands for surface samples (0 to 6 inches) ranged in concentration from 44 ppm up to 299 ppm (location WT-SD-92). The total PCB concentrations observed in the at-depth samples (1.5 to 2.0 feet) were significantly lower ranging from 2.6 ppm to 5.7 ppm.

Additional investigations were than proposed, focusing on the areas where the highest levels of PCB contamination were identified to further investigate and define the extent of contamination.

Phase III: *Report on PCB Investigation for Willow Brook and Willow Brook Pond*, prepared by LEA, dated April 1999. The purpose of this report was to present the findings of the third phase of PCB

investigations in Willow Brook and Willow Brook Pond. During this phase, soil samples were collected from soil borings and monitoring wells installed in the vicinity of Willow Brook Pond. In addition, surface sediment and soil samples to depths of up to 6 feet were collected along the banks of Willow Brook. Soil/sediment samples were collected from the wetland area at Willow Arms and from other adjacent residential properties along the portion of Willow Brook, which lies downstream of Willow Brook Pond and to the east of Main Street. Groundwater sampling was also performed in monitoring wells installed at the perimeter of Willow Brook Pond.

Willow Brook Pond Perimeter Sampling: Twelve soil borings and eight monitoring wells were installed in the vicinity of Willow Brook Pond to assess the lateral extent of the contamination. The borings and monitoring wells were installed using a Geoprobe® to a depth of approximately 20 feet. Hand borings to an approximate depth of 12 feet were installed in locations inaccessible by the Geoprobe®. Soil samples were collected every 2 feet and screened visually for the presence of oil. Three samples were submitted for PCB analysis from each boring, including the most contaminated one, based on visual observations, and random ones corresponding approximately to the depth of contamination obtained during the previous investigation. Total PCB concentrations of 50.87 ppm were observed to the east of the eastern water body at Willow Brook Pond, along the reinforced concrete pipe that conveys flow from Willow Brook into Willow Brook Pond. Relatively elevated PCB concentrations up to 14.33 ppm were observed in the area of the Former Oil-Water Separator between the two sections of Willow Brook Pond. This is consistent with previous findings and provides delineation of contamination in this area. Elevated concentrations of semi-volatile organic compounds (SVOCs) and select metals have been observed at some locations. The elevated compounds are consistent and appear to be co-located with the elevated PCB concentrations.

PCBs may have seeped into nearby soils at certain locations, for example at location WT-PZ--140 to the north of the larger water body of Willow Brook Pond (3.82 ppm). However, concentrations detected at depth are generally much lower or below detectable levels. The contamination was confirmed to be primarily contained within Willow Brook Pond.

Wetlands and Stream Bank Sampling: Soil/sediment samples were collected from several abutting residential properties along the segment of Willow Brook between Willow Brook Pond and Main Street. The samples were collected at different elevations along the bank of the brook to assess the lateral extent of contamination. Samples were also collected from the wetlands area at the Willow Arms property and from the adjacent portion of UTC/P&W's property. Surface soil/sediment samples were collected in a total of 28 locations. In seven of these locations, hand auger borings were advanced to approximately 6 feet to assess the vertical extent of contamination. Relatively elevated PCB concentrations (up to 596.2 ppm) were observed within the wetland area. Relatively elevated SVOC and select metals concentrations were also observed within this area, and, as stated before, are consistent and co-located with elevated PCB concentrations. The total PCB concentrations typically decrease to less than 1 ppm at a depth of 4 to 6 feet below grade. Similar concentrations were observed in the wetland area within UTC/P&W property. Total PCB concentrations up to 21.77 ppm were detected from sediment within Willow Brook in the off-site properties (downstream of the wetland area). The PCB concentrations observed drop substantially at higher elevations along the bank of Willow Brook, indicating that the contamination is confined within the brook and the wetland. PCB concentrations decrease to less than 1 ppm prior to Main Street.

Groundwater Sampling: Groundwater samples were collected by LEA personnel from the installed monitoring wells on December 4, 1998. Samples were collected using a peristaltic pump and dedicated polyethylene tubing. Of the eight monitoring wells installed, PCBs were only detected at two locations. PCBs were detected in groundwater from monitoring wells WT-PZ-136 [8.5 parts per billion (ppb)] and

WT-PZ-139 (0.73 ppb). These wells are in the vicinity of locations where the highest PCB concentrations in soil have been detected.

Surface Water Sampling: Surface water samples were collected from two locations at Willow Brook Pond (at the pumps from the larger water body prior to entering the facility for non-contact cooling water use and at the dam) and from Willow Brook (downstream of Willow Brook Pond at the intersection with Main Street). No PCBs were detected in any of the surface water samples collected.

1.4 Nature and Extent of Contamination

1.4.1 Soil and Sediment

Overall and with consideration of the data collected to date, PCB concentrations are generally distributed in the brook and pond sediments gradually decreasing in concentration in the downgradient direction. This decrease trends from > 100 ppm in the pond and wetland areas to a concentration of < 1 ppm at Main Street. PCBs were also found in the soils between the two ponds, where the former oil/water separator was located. The vertical extent of PCB impacts has been defined by the sampling conducted, generally achieving non-detect or concentrations < 1 ppm at depths ranging from 4 to 6 feet below grade in the off-site wetlands and 14 to 16 feet below grade in the pond area. Soil samples collected along and up the banks of the brook and ponds define the horizontal limits of PCB to non-detect or concentrations of < 1 ppm. Figures 1-3 and 1-4 depict the extent of PCB impact in the Willow Brook and Willow Brook Pond area. SVOCs and select metals are co-located with the elevated PCB concentrations.

1.4.2 Groundwater

Groundwater samples collected during the remedial investigation identified only two locations where PCB concentrations were above detection limits (WT-PZ-136 at 8.5 ppb and WT-PZ-139 at 0.73 ppb). Well WT-PZ-136 is located in the immediate vicinity of the former oil/water separator and locations of high PCB content in soil. Well WT-PZ-139 is adjacent to an area of elevated PCB in soils. It is expected that removal of soil and source material in these areas will address PCB in groundwater. As these areas and the previously sampled monitoring wells will be removed during RA, post-excavation groundwater monitoring will be conducted to confirm no impacts to groundwater remain following excavation. This monitoring will be conducted through the installation of new monitoring wells in the area.

1.4.3 Surface Water

Surface water sampling from Willow Brook and Willow Brook Pond was performed on February 6, 1998. Samples were collected from Willow Brook Pond at the pumps pumping from the larger water body and dam and from Willow Brook downstream of Willow Brook Pond at Main Street. No PCBs were detected in any of the surface water samples collected.

2.0 STATEMENT OF WORK

The remediation plan for Willow Brook and Willow Brook Pond involves the excavation and offsite disposal of soil and sediment containing total PCB concentrations in excess of 25 ppm. The remediation plan for the wetland area located north of Willow Brook involves the excavation and offsite disposal of soil and sediment containing PCB concentrations in excess of 1 ppm. Following excavation and removal of the impacted soil and sediment within Willow Brook and Willow Brook Pond, a cap consisting of an organic rich soil layer, a gravel layer and a stone layer will be placed within the limits of Willow Brook and Willow Brook Pond. The dam structure between Willow Brook Pond and the open channel section of Willow Brook will remain intact. The area will be restored to much the same configuration as exists today with two ponds (upper and lower Willow Brook Ponds) and an open channel (Willow Brook) from the downstream end of the pond to the cross culvert at Main Street. The existing wetland downstream of the pond will also be restored. Details regarding site restoration and capping are further discussed in Section 2.3.

As noted previously, soil and sediment within Willow Brook and Willow Brook Pond are also impacted by SVOCs, metals, and petroleum hydrocarbons. During the removal of PCB contaminated soil and sediment, a large percentage of the soils and sediment impacted by these constituents will also be removed. In any event, any remaining contamination will be capped as noted previously. Following remediation, UTC/P&W will implement two institutional controls to ensure the long-term protectiveness of the proposed remedy. The institutional controls consist of 1) a deed restriction to ensure the affected area will not be used for residential purposes and to prohibit excavation and 2) installation of a fence around the entire area to preclude access to Willow Brook and Willow Brook Pond.

The proposed 25 ppm total PCBs action level within Willow Brook and Willow Brook Pond assumes future use of the remediation area as an open pond to be flanked by parking and green space. In the event that redevelopment of this area involves a bike path or roadway, the area directly beneath those uses will be remediated to a total PCB concentration of less than 1 ppm. Furthermore, should redevelopment of the area necessitate remediation to less than 1 ppm, appropriate barriers (i.e. fencing or railings) would be installed between the capped areas and the areas remediated to less than 1 ppm.

2.1 General

This section details the work to be completed during the project. The section begins with a discussion of pre-construction activities including the application for necessary Federal, State of Connecticut and Town of East Hartford permits to complete the work, and the design of the project. This is followed by a discussion of the construction activities including site preparation, the demolition and removal of existing structures, contaminated soil and sediment excavation and offsite disposal, wetlands restoration, site restoration activities, implementation of institutional controls, and record keeping and reporting. The last part of this section details post-construction activities. This includes a discussion on the preparation of a post-remediation report detailing the remediation activities and a post-remediation groundwater monitoring program.

2.2 Pre-Construction Activities

This section contains a description of those activities that will be completed prior to the initiation of PCB removal activities at the site. The pre-construction activities are presented in three general categories: project permits, engineering design, and health and safety plan.

2.2.1 Project Permits

Prior to the initiation of construction activities and the completion of design activities, it will be necessary to obtain permits from a variety of regulatory agencies maintaining jurisdiction over the work. The agencies include the Army Corps of Engineers, the State of Connecticut Department of Environmental Protection, and the Town of East Hartford Inland Wetlands, and Planning and Zoning Commissions.

US Army Corps of Engineers

The work of this project involves the excavation of nearly 12,500 cubic yards of contaminated soil and sediment from within Willow Brook and Willow Brook Pond. The majority of the excavation activities occur within the two ponds, within the wetlands west of the ponds, or immediately adjacent to these areas. The construction activities will result in the disturbance of greater than 1-acre of wetlands within and immediately abutting the work. A permit from the Army Corps of Engineers is necessary prior to performing a construction activity that impacts greater than 1-acre of inland wetlands. In consideration of the fact that the project will result in the disturbance of greater than 1-acre of inland wetlands, the permit from the Army Corps of Engineers will be sought through the individual permit process. However, the potential exists that the permit will be issued as a Category II Permit under the Connecticut Programmatic General Permit as such permits can be issued for activities that impact 1 to 3 acres of degraded or low value wetlands. The approach to obtaining a permit from the Army Corps of Engineers will be determined during the initial phases of the project.

Connecticut Department of Environmental Protection

Prior to initiation of the construction activities, it will also be necessary to obtain a permit from the CTDEP Inland Water Resources Division. This permit will address the need to obtain approvals from the CTDEP to perform operations within State inland wetlands, to obtain a water quality certification for the excavation/placement of fill within the flood plain and wetlands pursuant to Section 401 of the Clean Water Act; to obtain a certification of flood management practices as a portion of the work will be conducted in the 100-year flood plain; and to obtain an approval to perform work riverward of the stream channel encroachment line of the Connecticut River.

The application to the IWRD will be prepared and submitted on forms approved by the DEP and will include: a permit application transmittal form; the permit application for programs administered by the IWRD; the technical documentation form; an executive summary; a USGS site location map; a listing of all adjacent property owners; applicant compliance and background information; a soil scientists report; an engineering/hydrogeologic report; flood management consistency worksheets; an environmental report; an alternatives assessment; a flood contingency plan; and plans and drawings detailing the work.

In addition to the above pre-construction permits, it will also be necessary to register for the General Permit for the Discharge of Storm Water and Dewatering Wastewaters Associated With Construction Activities and the General Permit for the Discharge of Groundwater Remediation Wastewater. The CTDEP Bureau of Water Management issues both General Permits. Registration packages will be submitted to the CTDEP prior to initiation of construction activities. In addition, a Storm Water Pollution Control Plan (a requirement of the storm water general permit) will be prepared prior to the initiation of construction activities.

Town of East Hartford

Prior to the initiation of construction activities, it will be necessary to obtain three permits from the Town of East Hartford. These permits will be issued by the Inlands Wetlands, and Planning and Zoning Commissions. The Inlands Wetlands Commission permit will be necessary prior to the performance of construction activities within wetlands or within specified distances from a wetland. The Planning and Zoning Commission permits will be in the form of a Major Flood Hazard Permit and an Excavation Permit. The Major Flood Hazard Permit will be necessary prior to performing construction activities within a flood hazard area of the Town of East Hartford. The Excavation Permit must be obtained prior to the excavation of greater than 500 cubic yards of soil in the Town of East Hartford. It should be noted, the Excavation Permit might not be necessary as a special exception may be sought as the construction activities are being undertaken as part of a remediation activity.

2.2.2 Engineering and Design

Prior to the implementation of the construction activities at the site, detailed design drawings and technical specifications will be prepared to depict each phase of the project. The construction drawings will be used in support of applications to obtain necessary permits as well as to direct the efforts during the construction activities. The technical specifications will be of adequate detail to ensure that each phase of construction is performed in accordance with the terms and conditions of any permits obtained prior to the initiation of construction, this Remedial Action Plan, and other applicable local, state and/or federal requirements.

2.2.3 Health and Safety Plan

A Health and Safety Plan (HASP) will be prepared prior to the initiation of construction activities. The HASP will detail safety organization, procedures, and personal protective equipment that are based on an analysis of potential site-specific hazards. The HASP, will meet the requirements of 29 CFR 1910 and 29 CFR 1926 (which includes 29 CFR 1910.120 and 29 CFR 1926.65). The HASP will include, but will not be limited to, the following components:

- Identification of key personnel - All on-site personnel involved with the construction activities at the site will be required to maintain Occupational Safety and Health Administration (OSHA) 40-hour Hazardous Waste Training (29 CFR 1910.120 and 29 CFR 1926.65) and the corresponding 8-hour refresher course update
- Training – A description of health and safety training requirements for supervisory and on-site personnel will be presented. Training requirements will include attending an initial site orientation prior to performing on-site activities
- Medical Surveillance – A description of appropriate medical examinations required for supervisory and on-site personnel.
- Site Hazards – A description of chemical, physical, and climatological hazards associated with the project.
- Work Zones – A description of the work zones that will be established during construction activities.
- Personnel Safety Equipment and Protective Clothing – A description of personnel protective equipment and protective clothing to be used and available on site.
- Equipment Cleaning – The methods and procedures for decontamination of personnel, materials, and equipment will be described.
- Confined Space Entry – A listing of confined spaces and description of procedures for confined space entry in accordance with Permit Required Confined Space Entry (29 CFR 1910.146).

- Excavation Safety – A description of excavation and trenching safety procedures as specified in 29 CFR 1926 Subpart P.
- Standard Operating Procedures and Safety Programs as required by applicable portions of 29 CFR 1910 and 29 CFR 1926.

2.3 Construction Activities

The proposed construction activities involve:

- The demolition of the existing process water facility building structures and the offsite disposal of construction demolition debris;
- The removal and offsite disposal of an oil/water separator and the excavation and offsite disposal of impacted soil in the vicinity of the oil/water separator and the placement of an engineered control to achieve compliance with the requirements of the RSR;
- The excavation and offsite disposal of approximately 8,500 cubic yards of soil and sediment containing total PCBs at concentrations greater than 25 ppm from within and immediately surrounding the Willow Brook and Willow Brook Pond;
- The excavation and offsite disposal of approximately 1,500 cubic yards of soil and sediment containing PCBs at concentrations between 1 and 25 ppm from within and immediately surrounding the wetland area located north of Willow Brook;
- The excavation and offsite disposal of approximately 2,500 cubic yards of soil and sediment from within the open channel of Willow Brook to allow for the installation of the geotextile, soil, and stone cap within the stream channel;
- The placement of a geotextile, soil and stone cap over the entirety of the excavated area (with the exception of an approximately 1-acre wetland described below) to isolate sediment containing less than 25 ppm total PCBs commingled with semi-volatile organic compounds, petroleum hydrocarbons, and select metals;
- The restoration of an approximately 1-acre wetland located downstream of the Willow Brook Pond Dam; and
- The implementation of two institutional controls consisting of 1) a deed restriction to ensure the affected area will not be used for residential purposes and to prohibit excavation; and 2) installation of a fence around the entire area to preclude access to Willow Brook and Willow Brook Pond.

The following parts of this section describe in general each of the anticipated construction activities necessary to complete the remediation.

2.3.1 Site Preparation

The following is a general description of anticipated site preparation activities.

Erosion Control

Appropriate soil erosion and sedimentation control methods (e.g., silt fence, straw bale dikes, absorbent booms, etc.) will be installed to mitigate the transport of suspended solids or sediments downstream. A soil erosion and sediment control plan is a component of applications for local, state and federal permits. Due to the magnitude of excavation to accomplish the removal of contaminated soil and sediment, excavation activities will not be performed during periods of heavy precipitation.

Clearing and Grubbing

The area in the immediate vicinity of Willow Brook and Willow Brook Pond is covered with a variety of vegetation, including the wetland areas (see Figure 1-2). Vegetation ranges from mowed grass to mature trees. To gain access to perform the planned excavation activities, clearing and grubbing will be required. Cutting, processing, and appropriate disposal of heavy vegetation will be a component of the project.

Decontamination Facilities

Contractor equipment that has been in contact with contaminated soil and sediment will require decontamination prior performing work in an uncontaminated area or demobilization from the site. Decontamination pads will be strategically located at the site adjacent to the excavations. The decontamination pads will generally be constructed of a wood frame or similar materials, lined with heavy plastic, and include a layer of open stone. Equipment that has come into contact with contaminated soil and sediment will be cleaned with a pressure washer over the decontamination pad.

Field sampling equipment (e.g., stainless steel trowels, plastic scoops, shovels, etc.) used to implement the Field Sampling and Analysis Plan will be decontaminated prior to each sample location to mitigate the potential for cross-contamination of samples collected for laboratory analysis. Decontamination will be performed in accordance with Standard Operating Procedures provided as Appendix B.

Wash water and detergents used in the decontamination process will be disposed of, following any necessary treatment, via the sanitary sewer in accordance with the terms and conditions of the CTDEP General Permit for the Discharge of Groundwater Remediation Wastewater.

Site Security

Limiting access to the site during construction will be accomplished thorough the use of both existing permanent fencing (along the north side of Willow Brook and Willow Brook Pond) and temporary construction fencing to be installed along Willow Street. The fencing will be supplemented by the use of security personnel to ensure that unauthorized persons do not access the construction site during remediation activities.

2.3.2 Demolition and Removal of Existing Structures

As part of the remedial activities, select buildings and other structures will be demolished (see Figure 2-1). A list and description of the primary structures to be demolished are as follows:

- Five buildings and components associated with the process water facility; and
- The abandoned underground oil/water separator located between the upper and lower sections of Willow Brook Pond.

Area Preparation

Prior to demolition, a complete survey of the structures and their components will be performed. The survey is necessary to determine decommissioning, demolition, and disposal requirements. UTC/P&W will be responsible for shutdown and removal of components they intend to reuse from the process water facility.

Process Water Buildings

Demolition of the process water buildings will extend to a depth necessary to achieve the project objectives of removal of soil and sediment containing total PCBs in excess of 25 ppm. Other related structures, such as pilings, erosion structures, etc., will also be demolished and removed to a depth necessary to achieve the project objectives. Pipes and utilities connected to these buildings will be abandoned during the demolition activities or during the soil and sediment removal phase of the project.

A Civil War marker/gravestone is located to the east of the main water processing building. UTC/P&W are currently discussing (both internally and with local community administrators) alternatives for protecting or permanently relocating this marker to a more appropriate area.

Former Oil/Water Separator

A buried oil/water separator is located between the upper and lower sections of Willow Brook Pond. This structure and surrounding soils are contaminated with PCBs. The oil/water separator, its contents, and the impacted soil surrounding the structure will be completely removed and disposed of at an offsite location during the project. Prior to removal of the structure, the oil/water separator will be exposed and any liquids will be removed, characterized, and disposed of at an offsite location.

Demolition Debris Management

Further evaluation of the affected structures and components will be performed to determine disposal requirements prior to demolition. Appropriate samples will be collected and submitted for laboratory analysis to characterize the waste for disposal. The sampling procedures and protocols are further discussed in Section 4.0, Field Sampling and Analysis Plan. It is anticipated that all material removed in the demolition process will be disposed of off site.

2.3.3 Contaminated Soil and Sediment Excavation and Offsite Disposal

This section presents a summary description of the planned soil and sediment excavation and offsite disposal activities. As noted, it is anticipated that approximately 12,500 cubic yards of contaminated soil and sediment will be excavated and disposed of at an offsite location during the project. In general, soil and sediment excavated as part of the remediation will be stockpiled in a staging area and stabilized with lime to eliminate free-draining water.

Stream Flow During Construction

The construction project involves the excavation of submerged sediments from within Willow Brook and Willow Brook Pond. Remediation will begin at the upstream pond and progress downstream. To accomplish the excavation, it will be necessary to temporarily redirect flow within Willow Brook. It is anticipated that the redirection will be accomplished through the use of portable dams to be erected within each pond. In essence, the dam will be installed to bisect the pond in a generally east/west direction to allow water to pass freely along one side of the dam while dewatering pumps are used to pump water from the side of the dam to be excavated. Once one side of the dam is free of water, excavation will proceed until sediment containing greater than 25 ppm total PCBs are removed from within Willow Brook and Willow Brook Pond. The area of excavation within Willow Brook and Willow Brook Pond will be restored with the geotextile, soil and stone cap, and a second temporary dam will be erected to allow water to flow from Willow Brook through the remediated area. The initial dam will be removed

and the second half of the pond will be remediated. This process will be used for both sections of Willow Brook Pond.

Stream redirection will also be necessary to remove soil and sediment from within the open channel section of Willow Brook extending from the Ponds to the culverts under Main Street. The removal of soil and sediment from within this reach will be necessary for the installation of the geotextile, soil, and stone cap. The redirection of flow in the reach of Willow Brook will also be accomplished through the use of portable dams to be installed in a generally east/west progression to bisect the channel.

The use of portable dams over conventional bypass pumping equipment was determined to be the most appropriate means of redirecting storm water flows anticipated. The portable dams are a readily available and reliable means to pass both dry-weather and wet-weather flows.

Dewatering

In addition to water diversion, it is also likely that construction dewatering will be necessary to facilitate the removal of soil and sediment containing greater than 25 ppm total PCBs. Conventional sump techniques will be employed to allow for spot dewatering of excavation areas. All dewatering wastewater will be managed and disposed of via the sanitary sewer, following appropriate treatment, in accordance with the terms and conditions of the CTDEP General Permit for the Discharge of Groundwater Remediation Wastewater.

Excavation Methods

The excavation program will advance from upstream to downstream within Willow Brook Pond and the Willow Brook streambed. The approximate horizontal limits of the soil and sediment removal activities are presented on Figure 2-1. Based on the prior investigations, it is anticipated that an average of 2 to 3 feet of sediment will be removed from the pond and brook and up to 4 feet within the wetland area. Soil from depths of up to 16 feet will be excavated in the vicinity of the oil/water separator. Confirmatory soil samples collected during the remediation will provide the final horizontal and vertical limits of excavation. The soil and sediment excavation will be accomplished through the use of track-mounted excavators, bull dozers, and loaders. It likely that some or all of the equipment will be of a low ground pressure configuration to allow operation within the pond and stream channel.

Once the target soils and sediment have been removed and verified, the excavation will continue and the placement of the geotextile, soil and stone cap (See Section 2.3.4) can proceed. Should the confirmatory samples indicate that the 25 ppm total PCB limit has not been achieved within the pond and brook or 1 ppm within the wetland area, additional excavation will be performed. Excavation will continue until all soil and sediment containing PCBs at concentrations in excess of 25 ppm within the pond and brook or 1 ppm within the wetland are removed.

Soil/Sediment Sampling and Analysis

Sampling and analysis of certain soils/sediments will be required to confirm horizontal and vertical limits, disposal and handling requirements. Soil and sediment confirmatory samples will be collected in accordance with the Field Sampling and Analysis Plan presented in Section 4.0. The excavated and staged soil and sediment will be sampled for disposal characterization. The soil and sediment disposal characterization samples will also be collected in accordance with the Field Sampling and Analysis Plan. All confirmatory and disposal characterization samples will be analyzed in accordance with the Quality Assurance Project Plan in Section 5.0.

Soil/Sediment Staging

During the soil and sediment removal activities the excavated soil and sediment will be relocated into staging areas adjacent to the excavation area for gravity dewatering and lime stabilization. The staging areas will consist of a perimeter berm and will be lined with polyethylene to contain all soils and liquids. Soil and sediment placed within the staging areas shall be covered with a low permeability sheet to limit exposure to precipitation. Water collecting within a staging area will be managed and disposed of via the sanitary sewer, following appropriate treatment, in accordance with the terms and conditions of the CTDEP General Permit for the Discharge of Groundwater Remediation Wastewater.

Stabilization

The excavated soil and sediment shall be staged for dewatering by gravity within a staging area in order to meet applicable requirements for disposal (i.e., no free liquids). It is anticipated that the soil and sediment will be stabilized utilizing up to six percent lime by weight. Lime will be evenly incorporated into the excavated soil and sediment via mechanical mixing.

Off-Site Disposal

It is anticipated that all soil and sediment excavated as part of this project will be shipped to an offsite facility for disposal. The offsite disposal includes handling, storing, containerizing, transporting (including providing and preparing manifests, bills of lading, etc.) and disposing of excavated soil and sediment. The excavated soil and sediment will be transported via a licensed waste hauler to a permitted solid waste disposal facility. The estimated in-place volume of soil and sediment requiring offsite disposal is 12,500 cubic yards.

2.3.4 Pond/Stream Channel Cap, Engineered Control, Wetland Restoration

Following the excavation and demolition activities, Willow Brook and Willow Brook Pond will be restored. The planned restoration activities are described in detail below and depicted on Figure 2-2. The site restoration involves the installation of 2 types of caps and an engineered control over soil and sediments remaining following excavation and removal of those containing total PCBs at concentrations greater than 25 ppm. The cap details were derived based on the anticipated stream flow velocities and considered the ultimate use of the area as a combined wetland, pond, and stream channel. The base of each cap consists of a non-woven geotextile, a 9-inch layer of organic rich soil, and a non-woven geotextile. This layer is referred to below as an organic-rich layer. This organic-rich layer is included as a contingency to mitigate any potential for PCBs to migrate vertically upward through the proposed soil and rock cap. Each cap and the engineered control are described below and depicted on Figure 2-3.

- Within Willow Brook Pond, a 36-inch soil and stone cap is proposed (refer to Figure 2-3). The cap will consist of a 9 inch organic rich layer, 21 inches of process gravel, and a 6-inch layer of 4-inch stone. As the flow velocity in Willow Brook Pond is extremely low and is controlled by the dam at the outlet to the pond, the stone lining will provide adequate protection against erosion.
- Within Willow Brook (downstream of the dam), a 36-inch soil and stone gabion cap is proposed (refer to Figure 2-3). The cap will consist of a 9 inch organic rich layer, 15 inches of process gravel, and a 12-inch thick stone gabion armor. The 12-inch thick gabion armor has been selected based on the ability to withstand significant erosive forces without deterioration. The gabions will be installed parallel to flow and consist of

a chain-link basket filled with 12-inches of stone. The stone is completely enclosed within the chain link enclosure and will be designed to sustain double the maximum anticipated velocity in Willow Brook.

- The area of the underground oil/water separator will be provided with an engineered control to comply with the requirements of the Connecticut Remediation Standard Regulation. The engineered control will consist of a 40-mil flexible membrane liner, a geotextile drainage layer, 30-inches of granular backfill, and a 6-inch loam and seed layer.

In addition to the above, the wetland north of Willow Brook will be restored by providing a soil and wetland sediment cap consisting of 24 inches of process gravel, and 12-inches of wetland soil. The wetland will be planted with native wetland plants.

2.3.5 Site Restoration

Following the completion of the excavation and offsite disposal of contaminated soil and sediment, all areas disturbed by construction will be restored. The restoration of the waterway and wetland were previously described. It is anticipated that restoration activities for area outside the waterway and wetland will consist of the installation of paved parking areas or grassed areas. Planned final site restoration is presented in Figure 2-2.

The future site use options may consist of the following:

- Additional automobile and/or truck parking; and
- Relocation/rerouting of Willow Street to the northern portion of the property as indicated on Figure 2-4.

Following restoration activities, UTC/P&W will implement two institutional controls to ensure the long-term protectiveness of the proposed remedy. The institutional controls consist of 1) a deed restriction to ensure the affected area will not be used for residential purposes and to prohibit excavation and 2) installation of a fence around the entire area to preclude access to Willow Brook and Willow Brook Pond (refer to Figure 2-2).

In the event that redevelopment of this area involves a bike path or roadway, UTC/P&W will remediate the areas directly beneath those uses to 1 ppm. Furthermore, UTC/P&W would install fencing between the capped areas and areas remediated to 1 ppm to eliminate potential access to the capped areas.

2.3.6 Record Keeping and Reporting

The following records will be maintained during construction to document the remedial activities:

1. The delineation of the final horizontal and vertical limits of the soil and sediment removal activities;
2. A photographic record of construction progress;
3. Records of all quality assurance/quality control (QA/QC) testing performed;
4. A record of all field screening and confirmatory sampling and analytical results, including sampling methods, locations and depths, frequency, and analytical results;
5. Results of all waste disposal characterization samples of excavated materials;

6. Results of all samples of treated effluent from the temporary on-site wastewater treatment system;
7. A record of all daily activities; quantities of materials removed, generated, used, and disposed of; and document manpower, material, and equipment used;
8. A record of all materials and equipment delivered to the site; and
9. Copies of all hazardous waste manifests, non-hazardous waste bills of lading, and certificates of disposal for wastes generated during the project.

2.4 Post-Construction Activities

The following is a general description of the post-construction activities. It is anticipated that the post construction activities will include the preparation of a report documenting the remediation of the site and the implementation of a post-remediation groundwater monitoring program.

2.4.1 Post-Remediation Reports

A post remediation report will be prepared for submission to the appropriate regulatory agencies. The report will contain a detailed description of remediation activities, confirmatory samples, offsite disposal documentation, appropriate figures and drawings, and analytical data tables presenting results of confirmatory samples. The report will be submitted to the CTDEP and EPA for review and ultimate approval. A separate report will be generated to satisfy the project closeout reporting requirements of the wetlands restoration efforts. The project closeout report is a likely condition of a permit or approval issued by the Army Corps of Engineers.

2.4.2 Post Remediation Groundwater Monitoring Program

Following completion of remedial activities, it will be necessary to perform post remediation groundwater monitoring of groundwater in the vicinity of Willow Brook and Willow Brook Pond. A Post-Remediation Groundwater Monitoring Program will be developed and submitted to the CTDEP and EPA for review and comment. The Post-Remediation Groundwater Monitoring Program will specify groundwater monitoring wells to be sampled, field collection and analytical methods, quality assurance/quality control procedures, program duration, and reporting requirements. It is anticipated that post-remediation groundwater monitoring will be performed on a quarterly basis for a period of not less than two years.

3.0 PROJECT SCHEDULE

The anticipated completion dates for major project activities are as follows:

- Permits from US Army Corps of Engineers, CTDEP and East Hartford June 2001
- Site Remediation Construction Period (Inclusive of Restoration) November 2001
- Post Remediation Report and Groundwater Monitoring Plan December 2001

A detailed project schedule is included as Figure 3-1.

4.0 FIELD SAMPLING AND ANALYSIS PLAN

4.1 Introduction

4.1.1 General

This plan addresses the field procedures, samples to be collected, sample type, sample location and the sample collection methods to be used during implementation of the remedial activities outlined in the RAWP. The Quality Assurance Project plan (QAPP), is presented in Section 5.0.

4.1.2 Objectives of the Sampling and Analysis Plan

The overall objective of the sampling and analysis program is to provide analytical data that verify the achievement of the remediation goals for the site. The sampling program will be implemented in accordance with 40 CFR Part 761 Section 761.61 (c) and in general compliance with Subpart O. The objective of this risk managed remediation program is to remove PCB-impacted soil exhibiting concentrations in excess of 25 ppm and place a 3-foot cap over the residual contamination areas (i.e., those areas that exhibit PCB concentrations less than 25 ppm). The proposed caps were described in previous sections. The portion of the wetlands to the north of the Willow Brook stream channel will be excavated to a concentration of 1 ppm PCBs. Based on the objectives of the remediation program, the following specific objectives have been established for the sampling and analysis program:

- Confirm that PCB concentrations remaining in soil/sediment at the limits of the excavation are consistent with the Remedial Action (RA) objectives; and
- Determine the handling and disposal requirements for the soil/sediment and miscellaneous materials generated during implementation of the RA.

4.1.3 Overview of the Sampling and Analysis Program

Analytical results associated with samples collected as part of the RA activities will be used to document that the objectives of the RA have been satisfied. Samples that will be collected as part of the RA will consist of the following:

- Post-excavation confirmatory soil/sediment samples to confirm the successful implementation of the RA and document residual contamination concentrations;
- Soil/sediment disposal characterization samples for assessment of disposal/reuse options; and
- Miscellaneous material samples for the assessment of disposal options and/or treatment performance (e.g., the temporary wastewater treatment system) associated with the implementation of the RA.

The location of the characterization samples performed and isoconcentration contours are shown on Figures 1-3 and 1-4 for Willow Brook and Willow Brook Pond, respectively. The proposed sampling grid for the confirmatory samples to be collected is shown schematically in Figure 4-1. In addition, disposal characterization samples will be collected from excavated materials associated with the RA.

4.2 Remedial Action Field Sampling

4.2.1 General

Details associated with implementing the Field Sampling Program (FSP) are presented in this section. The following information concerning the FSP is also provided:

- Proposed sample grid, sample identification numbers, and sample type;
- Procedures for sampling and for measuring field parameters; and
- A summary of the data to be generated from each sampling effort, including field and analytical parameters.

Detailed information regarding the RA field sampling including the number/type of environmental samples and quality control samples to be collected, sample intervals, analytical parameters, sample containers, preservation, and holding times are presented in tables located at the end of this section. A description of these tables is provided below:

Table No.	Title	Contents
4-1	Confirmatory Sample Summary	Presents the sample media, anticipated number of samples to be collected from the excavations, the sampling frequency, anticipated sample depth, and laboratory analytical parameters.
4-2	Quality Control Analyses Summary	Indicates the number and type of quality assurance/quality control (QA/QC) samples, which will be required.
4-3	Sample Containers, Preservation, and Holding Times For Soil/Sediment and Water Samples	Indicates the appropriate sample containers, preservation methods, and holding times for the samples to be collected.

All sampling activities will be performed in accordance with the Loureiro Engineering Associates, Inc. Standard Operating Procedures provided in Appendix B.

4.2.2 Post-Excavation Confirmatory Sampling

Post-excavation confirmatory sampling of soil/sediment will be conducted in the areas to be excavated (Figure 2-1) to confirm that residual PCB concentrations do not exceed the RA objectives at the limits of the excavations (25 ppm PCBs in all areas except 1 ppm PCBs in the wetland area to the north of the stream channel).

Post-excavation confirmatory soil/sediment samples will be collected from the bottom and sidewalls of the excavated areas of Willow Brook and Willow Brook Pond at a frequency of one sample per 400 square feet. A square grid will be set consisting of sampling points 20 feet apart based on north-south and east-west grid axes. The sampling points will proceed in every direction to the extent sufficient to result in a two-dimensional grid completely overlaying the excavation area. A grab sample will be collected at the center of each grid. Up to six grab samples will be composited to form one sample for PCB analysis

representing six adjacent square grids, as shown in Figure 4-1. However, one individual grab sample collected from the center point of one of the six adjacent square grids will be submitted for analysis for metals, VOCs, SVOCs, and cyanide as necessary to determine the lateral extent of the areas to be capped. The entire area to be excavated will be gridded including the slopes of Willow Brook and Willow Brook Pond and the sidewalls of the excavated area between the two water bodies of Willow Brook Pond.

Each confirmatory sample will be collected from a depth of 0 to 6 inches below the bottom of, or into the sidewalls of the excavation. The approximate extent of the areas to be excavated is shown in Figure 2-1.

Procedures for collecting post-excavation confirmatory soil/sediment samples are presented as follows:

- Soil/sediment will be collected from each of the discrete sampling locations that form a single composite sample;
- Samples for PCBs will be composited in the field using equal volumes of each of the six grab samples in sufficient volume to satisfy the analytical requirements
- The composite sample will be mixed thoroughly; and
- A final sample, of sufficient weight and volume will be collected from the composite sample to represent the post-excavated confirmatory soil/sediment sample.

Soil/sediment samples shall be collected using decontaminated spatulas, split-spoon samplers, augers or an equivalent. The materials and procedures to collect post-excavation confirmatory soil/sediment samples are presented below.

- Appropriate health and safety equipment;
- Plastic sheeting;
- Tape measure (50 feet or greater);
- Appropriate soil sample containers;
- Appropriate transport containers (coolers) with ice and appropriate labeling, packing, and shipping materials;
- Field forms and labels;
- Chain-of-custody forms; and
- Site map with post-excavation confirmatory soil/sediment locations.

Each component of the sampling device will be decontaminated or replaced with a new, dedicated, or disposable component prior to collecting soil/sediment samples for laboratory analysis. The sampling equipment will be decontaminated as previously discussed.

A portion of each confirmatory soil sample will be used for visual characterization. In addition, field analysis for PCBs at concentrations above the RA objective of 25 ppm PCB will be conducted using screening tests as for example rapid immunoassay screen test kits. The PCB field test kits are capable of detecting Aroclors 1248, 1254, and 1260. Standard operating procedures for PCB field test kits will be provided by the manufacturer.

The remaining portion of the sample will be placed in an appropriate laboratory supplied sample container and submitted for laboratory analysis provided the sample does not exhibit visible materials of concern, or contain PCBs at a concentration of 25 ppm or greater (based on the rapid immunoassay screen PCB field test results). If a sample exhibits one of the above-mentioned concerns, LEA will evaluate the need to advance the excavation and obtain additional confirmatory samples. Confirmatory samples will be submitted to the laboratory for analysis for PCBs (USEPA SW-846 Method 8082A revised Jan. 1998).

QA/QC soil/sediment samples will also be collected as described in Section 4.5.2 and in the QAPP presented in Section 5.0. Trip blanks, equipment blanks, duplicate samples and performance evaluation samples will be submitted for analysis. Table 4-1 presents the number of soil/sediment samples to be collected, and Table 4-2 presents the associated QA/QC soil sampling frequencies. Samples will be placed in appropriate laboratory supplied sample containers, preserved as described in Section 4.4.1, and labeled as described in Section 4.4.2. The samples will be handled, packaged, and shipped under appropriate chain-of-custody procedures as presented in Section 4.4.3.

4.2.3 Disposal Characterization Sampling

During the RA, grab disposal characterization samples will be collected from selected soil/sediment stockpiles to determine the appropriate method for the handling and disposal. The samples collected will be submitted for analysis for PCBs, metals, VOCs, SVOCs, and cyanide in select locations. Additional analyses such as total petroleum hydrocarbons (TPH) or total organic carbon (TOC) may be performed to satisfy disposal vendor requirements.

Field screening of the soil/sediment samples collected using field immunoassay kits may also be performed for disposal purposes to determine whether the PCB concentrations are above or below 50 ppm.

4.2.4 Miscellaneous Sampling

In addition to the sampling activities described above, additional sampling may be performed to determine handling and disposal requirements. These samples may include effluent samples from the temporary wastewater treatment system and debris from the demolition of the existing process water facility. A description of the sampling and analysis to be conducted for each of these materials is presented below.

Effluent Samples from the Temporary Wastewater Treatment System

Surface water or groundwater that enters the active remedial excavations and water generated from soil/sediment dewatering activities will be pumped to on-site storage tanks and treated on site at a temporary wastewater treatment system. During normal operation of the temporary wastewater treatment system, effluent samples will be collected and analyzed for specific parameters as required by the discharge permit. Effluent samples will be collected and analyzed in accordance to the frequency specified by the permit to confirm that discharge permit limits are achieved.

Demolition of the Existing Water Process Facility

As part of the RA, the existing process water facility will be demolished. Further evaluation of the building system and building components will be performed to determine disposal requirements; these requirements will be reviewed in the RD.

4.3 Sample Designation System

4.3.1 Sample Codes

A six-digit designation code and sample date will provide each sample with a unique sample identification number. This alphanumeric system will apply to all samples collected and submitted to the

designated laboratory for analysis. The designation codes that will be used for the samples collected, as part of the RA, are presented below:

Sample Type	Sample Location Designation
Confirmatory Soil/Sediment Samples	<ul style="list-style-type: none">• A prefix indicating that the sample was collected in the Waste Treatment area (WT-)• A designation (CS) indicating that the sample is a confirmatory sample;• A consecutive number indicating the sample collected.
Disposal Characterization Soil/Sediment Sample	<ul style="list-style-type: none">• A prefix indicating that the sample was collected in the Waste Treatment area (WT-)• A designation (DC-) indicating that the sample is a disposal characterization sample;• A consecutive number indicating the sample collected.
Temporary Wastewater Treatment System Effluent Samples	<ul style="list-style-type: none">• A prefix indicating that the sample was collected in the Waste Treatment area (WT-)• Samples of the effluent water from the treatment system will contain a the designation (EW) followed by a consecutive sample number.

Blind sample numbers will be assigned to the samples submitted to the laboratory for QA/QC purposes. The blind sample numbers will be associated with the sample location designations only in the field forms.

4.4 Sample Handling and Documentation

4.4.1 Sample Containers and Preservation

Appropriate sample containers, preservation methods, and laboratory holding times for samples collected as part of the RA are shown in Table 4-3. The analytical laboratory will supply appropriate sample containers, sample labels, and preservatives.

An example of a sample label, custody seal, field sampling record and chain-of-custody form are included in Figures 4-2 through 4--5 respectively.

4.4.2 Packing, Handling, and Shipping Requirements

Sample custody seals and packing materials for filled sample containers will also be provided by the analytical laboratory. The filled, labeled, and sealed containers will be placed in a cooler with ice and packed to eliminate the possibility of container breakage.

All samples will be packaged by the field personnel and transported as low concentration environmental samples. The packaged samples will be shipped either by carrier or hand delivered to the laboratory within 36 hours of sample collection.

4.4.3 Documentation

Field personnel will provide documentation for all aspects of field sampling, field analysis, and sample chain-of-custody. This documentation constitutes a record, which allows reconstruction of all field events to aid in the data review and interpretation process. All documents, records, and information relating to the performance of the fieldwork will be retained in the project file.

Various forms of documentation to be maintained throughout the RA include:

- Daily Production Documentation – Daily field forms containing a record of all field sampling activities.
- Sampling Information – Detailed notes will be made concerning the sample location, physical observations, sample depths, and weather conditions.
- Chain-of-Custody – Chain-of-custody forms will provide the record of responsibility for sample collection, transport, and submittal to the laboratory. Chain-of-custody forms will be filled out at each sampling site, at a group of sampling sites, or at the end of each day of sampling by one of the field personnel designated to be responsible for sample custody.
- Field Equipment Calibration, and Maintenance Logs – To document the calibration and maintenance of field instrumentation, calibration and maintenance logs will be maintained for each piece of field equipment.

4.4.4 Electronic Database

All data including field and analytical data collected will be maintained in a site-specific electronic database. The database already contains all characterization data obtained during the Willow Brook and Willow Brook Pond investigations to date. All data entered in the database will be verified for accuracy.

4.5 Management of Sampling-Related Materials and Wastes

The handling of sampling related materials and wastes is discussed below.

4.5.1 Disposable Equipment and Debris

Disposable equipment and debris, such as health and safety equipment, plastic sheeting, sampling equipment, and other equipment and/or sampling debris not reused during the RA will be collected in plastic bags during sampling and placed into appropriately labeled containers. At the end of the RA, the contents will be transferred into appropriate containers for off-site disposal.

4.5.2 Decontamination Rinsate

Decontamination rinsate will be containerized at a controlled, centralized location in labeled 55-gallon drums. Upon completion of the field sampling activities, the rinsate will be disposed of or treated at the on-site temporary wastewater treatment system.

4.6 Field Quality Assurance/Quality Control

This section summarizes the Quality Assurance/Quality Control (QA/QC) requirements for sampling activities associated with the RA at the site.

4.6.1 Field Instrument Calibration and Preventative Maintenance

Field personnel will document the calibration and maintenance of all applicable field equipment in the appropriate field forms.

4.6.2 QA/QC Sample Collection

QA/QC samples will be collected at a frequency of one every 20 samples and submitted to the laboratory for analysis. The number of QA/QC field samples to be collected is provided in Table 4-2. The type of QA/QC samples to be collected during the RA includes trip blanks, equipment blanks, duplicate samples, aqueous performance evaluation (PE) samples, and matrix spike/matrix spike duplicate (MS/MSD) samples. Guidance on the collection of the QA/QC samples is presented below:

Trip Blanks

Trip blanks will be collected at a frequency of one every 20 samples to ensure that the samples are not contaminated by VOCs while in transit to the laboratory. The equipment blanks will be prepared by the laboratory and delivered along with the sample glassware. No trip blanks will be collected in sample batches that do not include analysis for VOCs.

Equipment Blanks

Equipment blanks are collected as a check that the decontamination procedure has been adequately performed and that cross-contamination of samples will not occur due to the sampling equipment. Equipment blanks will be prepared in the field by pouring laboratory supplied analyte-free water into or over decontaminated sampling equipment and then directly into the laboratory supplied sample bottles. One equipment blank will be collected for each representative type of equipment used (i.e., spoons, bowls, split-spoon sampler, etc.) for every 20 samples collected and/or at a minimum of once per week.

Duplicate Samples

Duplicate samples will be sent for laboratory analysis to evaluate the reproducibility of the sampling technique used. Duplicate samples will be collected at a frequency of one every 20 samples collected.

Performance Evaluation Samples

Performance evaluation samples will be sent for laboratory analysis to ensure that environmental data collection results in the delivery of analytical data of known and documented quality, suitable for its use. Aqueous PE samples for each suite of analytes (PCBs, metals, VOCs, SVOCs, and cyanide as applicable) will be collected at a frequency of one every 20 samples collected. The analytical results of the PE samples will be evaluated following USEPA Region I Performance Evaluation Sample Guidance – Attachment H, July 1996. The PE samples will be counted as field samples in the 20-sample SDG total.

5.0 QUALITY ASSURANCE PROJECT PLAN

5.1 Introduction

5.1.1 General

This Quality Assurance Project Plan (QAPP) has been prepared in accordance with the USEPA referenced document SW-846 and presents analytical methods and procedures which will be used during implementation of the Remedial Action (RA0, as outlined in the Remedial Action Work Plan, (RAWP).

5.1.2 Objectives of the Quality Assurance Project Plan

The objective of the QAPP is to present the quality assurance/quality control (QA/QC) procedures to be implemented during the RA. The QAPP ensures that the data generated is of sufficient quality and quantity to allow confirmation that the RA objectives for the site are achieved. The sampling objectives of the QAPP are as follows:

- Confirm that residual PCB soil/sediment concentrations (at the horizontal and vertical limits of the excavation) satisfy the objectives of the RA;
- Determine handling and disposal requirements for the soil/sediments generated during the RA; and,
- Determine handling and disposal requirements for the miscellaneous materials generated during the RA.

5.1.3 Remedial Action Data Quality Objectives

To obtain data necessary to meet the objectives previously stated, the following categories of field sampling will be conducted as part of the RA:

- Post-excavation confirmatory soil/sediment samples to confirm the successful implementation of the RA and document residual contamination concentrations.
- Soil/sediment disposal characterization samples for assessment of disposal options; and
- Miscellaneous material samples for the assessment of disposal options and/or treatment performance (e.g., the temporary wastewater treatment system) associated with the implementation of the RA.

Preliminary Data Quality Objectives (DQOs) were identified to ensure that the data generated during field sampling will be of adequate quality and sufficient quantity to form a sound basis for decision making purposes relative to the above objectives. DQOs have been specified for each data collection activity.

DQO summaries for the RA activities are presented in the following section. The summary consists of stated DQOs relative to the following items:

- Data Uses;
- Data Types;
- Data Quality;
- Data Quantity;
- Sampling and Analytical Methods; and

- Data Precision, Accuracy, Representativeness, Completeness, and Comparability Parameters (PARCC Parameters).

The categories of analytical data discussed in the following sections with regard to data quality are defined as follows:

Screening Data: Screening data will be used to provide a quick assessment of site characteristics or conditions. This objective for data quality is available for data collection activities that involve rapid, non-rigorous methods of analysis and quality assurance. This includes field measurements such as immunoassay test kit results. This data will be reviewed and verified for accuracy and completeness as the field forms are processed by the LEA task manager.

Disposal Characterization Data: This includes all disposal characterization data, debris sampling and routine wastewater sampling prior to discharge. This data will be generated by a state-certified laboratory using EPA-approved analytical methods. The data will be reviewed for accuracy and data verification will be performed. This data will also be entered in the site-specific database. No data validation will be performed.

Confirmatory Data: Confirmatory data will be generated from a state-certified analytical laboratory using EPA-approved analytical methods. The data will be reviewed for accuracy and data verification will be performed. A Tier II data validation will be performed on the confirmatory data obtained in accordance with EPA Region I data validation guidelines. This data will also be entered in the site-specific database.

5.1.4 Post-Excavation Confirmatory Soil/Sediment Sampling

Data Uses

Post-excavation confirmatory soil/sediment sampling will be conducted to confirm that residual concentrations of PCBs, metals, VOCs, SVOCs, and cyanide (if applicable) present at the limits of excavations in the excavated areas are below the RA objectives.

Data Types

Confirmatory soil/sediment sampling will include the collection and analysis of samples for PCBs, metals, VOCs, SVOCs, and cyanide (if applicable). Table 4-2 of the QAPP presents the anticipated number of confirmatory soil/sediment samples to be collected and the laboratory analysis to be performed. Visual observation, and field screening of soil/sediment samples using PCB immunoassay field test kits will also be conducted to select soil/sediment samples for laboratory analysis.

Data Quality

Sample analysis for PCBs, metals, VOCs, SVOCs, and cyanide (if applicable) will be conducted in accordance with the methods referenced in the USEPA document SW-846. In addition, field screening of soil/sediment samples will be performed using PCB immunoassay field test kits in accordance with the Standard Operating Procedures (SOPs) provided by the manufacturer. The results will be presented using a Tier II laboratory data quality package and final electronic deliverables.

QA/QC samples will be performed for the confirmatory soil/sediment samples collected. No QA/QC samples will be performed for the screening immunoassay data. The number and type of QA/QC soil/sediment samples to be analyzed are summarized in Table 4-2.

Data Quantity

The location, number and type of analysis of post-excavation confirmatory soil/sediment samples to be analyzed from the excavation area will be determined based on a 20-ft grid as discussed in the previous section. The samples collected will be analyzed for PCBs, metals, VOCs, SVOCs, and cyanide in select areas.

Sampling and Analysis Methods

The Field Sampling Plan contains a description of the post-excavation confirmatory, disposal characterization and additional miscellaneous sampling procedures to be employed during the RA. The project-specific laboratory analytical methods and reporting limits are listed in Table 5-1 of this QAPP.

Precision And Accuracy Quality Control Limits (PARCC) Parameters

Precision and accuracy quality control limits for chemical constituents that are used during data review to assess analytical performance, are included in Tables 5-2 and 5-3. Data comparability will be achieved through the use of standard CTDEP/USEPA approved methods. Data completeness will be assessed at the conclusion of the RA.

5.1.5 Disposal Characterization Sampling

Data Uses

Disposal characterization sampling will be conducted to determine handling requirements for soil/sediment excavated during the RA.

Data Type

The disposal characterization sampling will include the collection of soil/sediment samples for field screening for PCBs using an immunoassay field test kit.

Data Quality

Laboratory analysis for PCBs will be performed in accordance with the methods referenced in USEPA SW 846. The results will be presented using a standard laboratory report format and final electronic deliverables. Field screening of soil/sediment samples may be performed using field test kits in accordance with SOPs provided by the manufacturer.

Data Quantity

Typically, one composite disposal characterization sample will be collected for every 500 CY of soil/sediment removed from a RA excavation area as directed by LEA. LEA may elect to perform disposal characterization sampling at an alternate frequency based on review of previous investigation data to aid in the evaluation of disposal options. QA/QC disposal characterization samples will not be submitted for laboratory analysis.

Sampling and Analytical Methods

The Field Sampling Plan presents a description of the disposal characterization soil/sediment sampling procedures to be employed during the RA. The laboratory methods to be utilized are presented on Table 5-1 of this QAPP.

Precision And Accuracy Quality Control Limits (PARCC) Parameters

Precision and accuracy quality control limits for chemical constituents analyzed as part of the characterization sampling will not undergo data review. Data comparability will be achieved through the use of standard CTDEP/USEPA approved methods. Data completeness will be assessed at the conclusion of the RA.

5.1.6 Miscellaneous Sampling

Data Uses

Miscellaneous sampling will be conducted to generate data to determine handling requirements for the following material, which will be generated during implementation of the RA:

- Effluent from the temporary wastewater treatment system; and
- Building components from demolition of the existing on-site process water facility.

Data Types

The miscellaneous sampling will include the collection and analysis of samples for laboratory analysis as described below:

- Surface water and/or groundwater which enters the active excavation area and water generated from soil/sediment dewatering activities (as applicable) will be pumped to an on-site temporary wastewater treatment system. Effluent samples from the temporary wastewater treatment system will be submitted for laboratory analysis, as described below, to confirm that limits for discharge to the local sanitary sewer system are achieved.
- Samples of identified existing process water facility components will be submitted for laboratory analysis to determine disposal requirements during the demolition process.

Data Quality

Sample analysis for miscellaneous samples will be conducted in accordance with USEPA standard methods. Results for the miscellaneous samples will be presented in a standard laboratory report.

Data Quantity

The number of miscellaneous samples to be collected as part of the RA is presented below:

- Samples of the effluent water from the temporary on-site wastewater treatment system will be submitted based upon the requirements of the discharge permit; and
- The number of samples from the demolition of the process water facility will be determined during the RA effort.

Sampling and Analytical Methods

Field instruments used during the program will be calibrated daily to confirm appropriate analyses, as applicable. A summary of potential field equipment and calibration data is included in Table 5-4. Samples of building components will be submitted for laboratory analysis for PCBs, metals, VOCs, SVOCs and other analytes as required by disposal vendors using EPA-approved methods. Samples of effluent from the temporary water treatment system will be analyzed for those parameters specified in the discharge authorization.

Precision And Accuracy Quality Control Limits (PARCC) Parameters

Precision and accuracy quality control limits will not be reviewed for miscellaneous samples submitted for laboratory analysis as part of the RA.

Data representativeness is addressed by the sample quantities and/or locations identified in the Field Sampling Plan. Data comparability will be achieved through the use of standard USEPA/CTDEP approved methods. Data completeness will be assessed at the conclusion of the RA.

5.2 Project Organization and Responsibilities

5.2.1 Project Organization

The RA will require integration of personnel from the organizations identified below, referred to as the project team. A detailed description of the responsibilities of each members of the project team is presented below.

5.2.2 Overall Project Management

LEA, on behalf of UTC/P&W, has overall responsibility for the RA at the site. LEA will perform the confirmatory soil/sediment sampling, disposal characterization sampling and miscellaneous sampling described in the Field Sampling Plan. In addition, LEA will be responsible for evaluating resultant sampling data and preparing required data submittals. UTC/P&W will provide project direction and oversight.

5.2.3 Team Member Responsibilities

This section of the QAPP discusses the responsibilities and duties of the project team members.

UTC/P&W

UTC/P&W Project Manager responsibilities and duties include:

- Overall direction of the RA;
- Direction of LEA; and
- Review of LEA work products, including data, memoranda, letters, reports, and all documents transmitted to the USEPA and CTDEP.
- Assure corrective actions are taken for deficiencies cited during audits of sampling/analytical activities.

LEA

LEA's responsibilities and duties include:

- Oversight of remedial work activities and products; and
- Coordination with UTC/P&W, USEPA and CTDEP.

More specifically, LEA personnel will have the following responsibilities:

LEA Project Manager

Responsibilities and duties include:

- Management and coordination of all aspects of the project as defined in the RAWP with an emphasis on adhering to the objectives of the RA; and
- Coordination of office and field activities with P&W/UTC.

LEA Task Manager

Task Manager (Project Engineer/Geologist), as set forth in Section 5.2.3 will manage the ongoing sampling and analysis activities associated with the RA. Responsibilities and duties of each Task Manager include:

- Manage day to day remedial sampling activities;
- Develop, establish, and maintain files on remedial sampling activities;
- Review data from the remedial sampling activities;
- Assure corrective actions are taken for deficiencies cited during audits of remedial sampling activities;
- Overall QA/QC of the portions of the RA;
- Review all field records and logs;
- Instruct personnel working on remedial sampling activities;
- Coordinate field and laboratory schedules pertaining to remedial sampling activities;
- Ensure in coordination with the Quality Assurance Manager the preparation of QA/QC samples including performance evaluation samples;
- Request sample bottles from the laboratory;
- Review the field instrumentation, maintenance, and calibration to meet quality objectives;
- Prepare sections of reports pertaining to relevant RA; and
- Maintain field and laboratory files of field forms and logs, data reductions and calculations.

LEA Field Sampling Personnel

The field sampling personnel's responsibilities and duties include:

- Prepare sample labels and field paperwork
- Perform field procedures associated with the collection of samples as set forth in the FSP;
- Perform field analyses and collect QA samples;
- Calibrate, operate, and maintain field instrumentation equipment;
- Reduce field data;
- Maintain sample custody; and

- Complete field records and logs and provide copies to the LEA Task Manager.

Quality Assurance Manager (QAM)

The QAM's responsibilities and duties include:

- Review laboratory data packages;
- Coordinate field QA/QC activities with task managers, included audits of sampling activities, concentrating on field analytical measurements and practices to meet data quality objectives;
- Review audit reports; and
- Prepare interim QA/QC compliance reports.
- The QAM will be independent of the unit generating the data.

5.2.4 Analytical Laboratory

Selected Analytical Laboratory

The selected analytical laboratory's general responsibilities and duties include:

- Perform sample analyses and associated laboratory QA/QC procedures;
- Supply sampling containers, shipping packages, and preservatives;
- Maintain laboratory custody of sample; and
- Strictly adhere to all protocols in the QAPP.

Laboratory Project Manager

The Laboratory Project Manager's responsibilities and duties include:

- Serve as primary communication contact between LEA and the laboratory technical staff;
- Monitor work loads and ensure availability of resources;
- Oversee preparation of analytical reports;
- Provide data validation packages as requested, and
- Supervise in house chain-of-custody.

Laboratory Quality Assurance Manager

The Laboratory QAM's responsibilities and duties include:

- Supervise the group which reviews and inspects all project related laboratory activities; and
- Conduct audits of all laboratory activities.

Laboratory Sample Custodian

The Laboratory Sample Custodian's responsibilities and duties include:

- Receive all samples; and
- Maintain custody of the samples and all documentation.

Laboratory Data Reviewer

The Laboratory Data Reviewer's responsibilities and duties include:

- Verify final analytical data prior to transmittal to LEA.

5.3 Quality Assurance Objective for Measurement of Data

5.3.1 General

This section identifies the parameters that will be measured in the field and parameters that will be analyzed in the laboratory as part of the RA sampling. This section also identifies the quality assurance parameters objectives for field measurement/laboratory analysis.

5.3.2 Field Parameters and Methods

Selected soil/sediment samples collected during the RA may be screened using PCB field test kits.

5.3.4 Laboratory Parameters and Methods

As described in the Field Sampling Plan, laboratory analyses will be performed during the RA to determine concentrations of the following:

- PCBs, metals, VOCs, SVOCs, and cyanide in confirmatory soil/sediment samples;
- PCBs, metals, VOCs, SVOCs, and cyanide in disposal characterization samples; Additional analyses may be performed to satisfy disposal vendor requirements.
- Specific analyses as required by the applicable permit(s) for samples of the effluent water from the temporary on-site wastewater treatment system; and
- Miscellaneous samples to be determined for disposal of demolition debris from the existing process water facility.

QA/QC analyses will be performed for analyses of PCBs, metals, VOCs, SVOCs, and cyanide as set forth on Table 4-2. Table 5-1 presents the reporting limits for each of the analyses.

5.3.5 Quality Assurance Objectives

The overall quality assurance objective for the RA sampling and analysis program is to develop and implement procedures for sampling, preservation, chain-of-custody, laboratory analysis, instrument calibration, data reduction and reporting, internal quality control, audits, preventative maintenance, and corrective actions, such that valid data will be generated. The measurement performance criteria will be communicated to the laboratory by the LEA Project Manager in order to ensure that the data users' quality objectives are linked to verifiable measurement performance criteria. These procedures are presented in the following sections of the QAPP. Specific QC checks are also discussed in the following sections.

Quality assurance objective are generally defined in terms of five parameters:

- Representativeness;
- Comparability;
- Completeness;
- Precision; and

- Accuracy.

Each of the parameters mentioned above are discussed below. Specific objectives for the RA sampling and analysis program are set forth in other sections of this QAPP.

5.3.6 Representativeness

Representativeness is the degree to which sampling data accurately and precisely represents site conditions, and is dependent on sampling and the variability of environmental media at the site. The sampling program has been designed to assess the presence of the chemical constituents at the time of sampling. The FSP presents the rationale for sample quantities and location. The FSP and this QAPP presents field sampling methodologies and laboratory analytical methodologies, respectively.

5.3.7 Comparability

Comparability is the degree of confidence with which one data set can be compared to another. Comparability throughout the RA will be maintained through consistent use of the sampling and analytical methodologies set forth in this QAPP and the FSP through the use of established QA/QC procedures, and the utilization of appropriately trained personnel.

5.3.8 Completeness

Completeness is defined as a measure of the amount of valid data obtained from an event compared to the total amount that was obtained. This will be determined upon final assessment of the analytical results, as discussed in Section 5.11 of this QAPP.

5.3.9 Precision

Precision is a measure of the reproducibility of sample results. The goal is to maintain a level of analytical precision consistent with the objective of the SAP. To maximize precision, specific sampling and analytical procedures will be followed. All sampling and analysis work for this RA will adhere to the established protocols presented in the QAPP and Field Sampling Plan. Checks for analytical precision may include the analysis of matrix spike, matrix spike duplicates, laboratory duplicates and field duplicates. Checks for field measurement precision may include obtaining duplicate field measurements.

5.3.10 Accuracy

Accuracy is a measure of how close a measured result is to the true value. Both field and analytical accuracy will be monitored through initial and continuing calibration of instruments (see Table 5-4). In addition, reference standards, matrix spikes, blank spikes, and surrogate standards may be used to assess the accuracy of the analytical data.

5.4 Sampling Procedures

Post-excavation confirmatory soil/sediment samples, disposal characterization samples and miscellaneous samples will be collected as described in the FSP. In the event of a variance in the field sampling procedures, a case narrative will be included in the field notes. The narrative will describe the nature of the variance in procedure, the reason for the variance, any effect the action may have on the data, and any corrective action taken. The LEA Project Manager will be notified immediately of any variance taken in field and/or laboratory procedures.

Sample containers will be ordered from the laboratory to ensure a sufficient number are in inventory at least 3 days prior to sampling. The number of containers will be in excess of the expected number of samples collected to prevent a shortage due to breakage. Chain-of-custody forms and custody seals (if necessary) will be kept in inventory in a similar manner.

5.5 Sample and Document Custody

5.5.1 General

This section identifies the field and laboratory procedures for the handling and documentation of samples collected as part of the RA. The field and laboratory sample handling and documentation procedures are presented below.

5.5.2 Field Procedures

The objective of field procedures for sample custody is to assure that samples are not tampered with from the time of sample collection through time of transport to the analytical laboratory. Persons will have “custody of samples” when the samples are in their physical possession, in their view after being in their possession, or in their physical possession and secured so the samples cannot be tampered with.

5.5.3 Laboratory Procedures

This subsection presents information related to laboratory sample custody, sample receipt and storage, sample analysis, laboratory documentation, and laboratory project files.

Sample Custody

Upon sample receipt, laboratory personnel will be responsible for sample custody. The original field chain-of custody form will accompany samples requiring laboratory analysis. Samples will be kept secured in the laboratory until all stages of analysis are complete.

Sample Receipt and Storage

Immediately upon sample receipt, the laboratory sample custodian will verify the package seal, open the package, and compare the contents against the field chain of custody and sign as recipient. If a sample container is received broken, the sample is in an inappropriate container, or has not been preserved by appropriate means, LEA will be notified. The laboratory sample custodian will be responsible for logging in the samples, assigning a unique laboratory identification number to each sample, labeling the sample bottle with the laboratory identification number, and moving the sample to an appropriate storage location to await analysis.

Sample Analysis

Analysis of an acceptable sample will be initiated by worksheets, which contain all pertinent information for analysis. The analyst will sign and date the laboratory chain of custody form when removing the samples from storage.

Samples will be organized into sample delivery groups (SDGs) by the laboratory. A SDG may contain up to 20 field samples (field duplicates, performance evaluation samples, trip blanks, and equipment blanks are considered field samples for the purposes SDG assignment). All field samples assigned to a single

SDG shall be received by the laboratory over a maximum of five calendar days (less, when five-day holding times for extraction must be met), and must be processed through the laboratory (preparation, analysis and reporting) as a group. Every SDG will include a minimum of one site-specific matrix spike/matrix spike duplicate (MS/MSD or MS/Dup) pair, which shall be received by the laboratory as part of the SDG assignment.

Each SDG will be self-contained for all of the required quality control samples. All parameters within an SDG will be extracted and analyzed together in the laboratory. At no time will the laboratory be allowed to run any sample (including QC samples) at an earlier or later time than the rest of the SDG. These rules for analysis will ensure that the quality control samples for an SDG are applicable to the field samples of the same SDG, and that the best possible comparisons may be made.

In case of a failure in the analytical system, the laboratory will be responsible for the necessary corrective action as described by the laboratory SOP or the analytical method. Any questionable laboratory data will be subjected to data validation as described in Region I, EPA-New England Data Validation Functional Guidelines For Evaluating Environmental Analyses, Rev. December 1996. As noted above, data validation packages will be requested for all confirmatory sampling data.

In the event of a variance in the laboratory analysis procedures, a case narrative will be included in the laboratory data package. The narrative will describe the nature of the variance in procedure, the reason for the variance, any effect the action may have on the data, and any corrective action taken. The LEA Project Manager will be notified immediately of any variance taken in field and/or laboratory procedures.

Laboratory Project Files

The laboratory will establish a file for all pertinent analytical data generated during the RA. The file will include the chain of custody forms, raw data, chromatograms (required for all constituents analyzed by chromatography), and sample preparation information. The laboratory will retain all project files and data packages for a period of five years.

Laboratory Documentation

Workbooks, bench sheets, instrument logbooks, and instrument printouts are used to trace the history of the samples through the analytical process, and document and relate important aspects of the work, including the associated quality controls. As such, all logbooks, bench sheets, instrument logs, and instrument printouts are part of the permanent record of the laboratory.

Each page or entry is dated and initialed by the analyst at the time of entry. Errors in entry are crossed out in indelible ink with a single stroke, corrected without the use of whiteout or by writing directly over the erroneous entry, and initialed and dated by the individual making the correction.

Laboratory notebooks are periodically reviewed by the laboratory group leaders for accuracy, completeness, and compliance to this QAPP.

Computer and Hard Copy Storage

Gas Chromatograph/Mass Spectrometry (GC/MS) raw data files are maintained on computer disk for five years, hard copy GC chromatograms are maintained in files for a minimum of five years, or as dictated by the policy of the selected laboratory.

Sample Storage Following Analysis

The laboratory maintains samples for a minimum of one month after the final report is delivered to LEA, or for a duration equal to the sample holding time. After this period, the samples shall be transferred to P&W/UTC for disposal in accordance with applicable rules and regulations.

5.6 Calibration Procedures and Frequency

5.6.1 Field Equipment Maintenance and Calibration Procedures and Frequency

Any field equipment will be thoroughly inspected on a daily basis. Any equipment deficiencies will be noted and remedied prior to leaving for the site. Any equipment found not in good working order will be repaired or replaced as necessary. No equipment shall return to field use unless found to be in good working order after repair. The LEA Equipment Manager will be responsible for assuring replacement equipment is available in case of equipment malfunction. In the event of equipment malfunction, replacement equipment in good working order will be transported to the site.

Any critical spare parts for field equipment will be in stock prior to the start of the project. After the project begins, the inventory of spare parts will be replenished as needed by the Equipment Manager. Specific procedures for performing and documenting calibration and maintenance for the field equipment for total organic vapors are provided in the FSP. Field equipment, frequency of calibration, and calibration standards are provided in Table 5-4. Maintenance will be performed according to the instrument instruction manual. Any critical spare parts for field equipment will be in stock prior to the start of the project. After the project begins, the inventory of spare parts will be replenished as needed by the Equipment Manager.

Calibration standards for the pH meter, conductivity meter, and turbidity meter are purchased as solutions certified by the manufacturer.

5.6.2 Laboratory Equipment Calibration Procedures and Frequency

Instrumentation calibration will follow the specifications provided by the SOPs for the analytical methods used as outlined in USEPA SW846.

5.7 Analytical Procedures

5.7.1 Field Analytical Procedures

Field analytical procedures may include field screening for PCBs using a field test kits. Specific field measurement quality in terms of precision and accuracy are presented in Table 5-5.

5.7.2 Laboratory Analytical Procedures

Specific requirements related to each sample medium to be analyzed and details of the methods to be used for this project are presented in the subsections below. The methods to be include the following:

- Standard USEPA methods will be used for the laboratory analysis of PCB's and the required analyses for the RA material disposal and permit requirements.
- CTDEP approved methods and updates will be used for laboratory analysis where applicable.

The anticipated turnaround times for receipt of analytical results for samples are summarized in the table below.

Sample Type	Turnaround Time
Post-excavation soil/sediment samples	24 hours to 2 weeks
Disposal characterization samples	24 hours to 2 weeks
Effluent samples from wastewater treatment system	24 hours to 2 weeks
Water treatment building demolition	1 week to 2 weeks

5.7.3 General Analytical Requirements

The number of environmental and QC samples to be analyzed are summarized in Table 4-2. The analytical parameters, methods and reporting limits are presented in Table 5-1.

5.7.4 Remedial Action Sample Matrices

Soil/Sediment, and Solids

Soil/sediment and solids analytical results will be reported on a dry weight basis, in the units presented in Table 5-1. Moisture content will be reported separately. QC limits for soil/sediment samples to be analyzed for PCBs, metals, VOCs, SVOCs and cyanide (at select locations) are presented in Table 5-2.

Water

Water from the temporary wastewater treatment system in this category that will be analyzed. Analytical results for the water analysis will be reported in the units identified in Table 5-1.

Analytical Requirements

The primary sources for methods used to analyze soil/sediment are provided in the USEPA documents. LEA will assess data usability of PCBs. The primary sources for methods used to analyze water samples associated with the on-site temporary wastewater treatment system are provided in 40 CFR 136.

Tables summarizing QC limits required to evaluate analytical performance are provided as follows:

Table	Title
5-2	Soil Analysis Quality Control Limits
5-3	Water Analyses Quality Control Limits

5.8 Data Reduction, Review, and Reporting

After field and laboratory data are obtained, the data will be subject to the following:

- Reduction or manipulation mathematically or otherwise into meaningful and useful forms;
- Review;
- Organization, interpretation, and reporting; and
- External data review.

The subsections below present descriptions of the data reduction, review, and reporting activities that will be conducted in the field and laboratory as part of the RA sampling and analysis program.

5.8.1 Field Data Reduction

Information collected in the field through visual observation, manual measurement and/or field instrumentation will be recorded in field forms. The LEA Task Manager will review such data for adherence to the FSP and for consistency. Concerns identified as a result of this review will be discussed with the field personnel, corrected if possible, and as necessary, incorporated into the data evaluation process. Data reduction will be performed for the confirmatory soil/sediment sampling and the disposal characterization soil sampling associated with determining PCB concentrations using a field test kits.

5.8.2 Field Data Review

Field data calculations, transfers, and interpretations will be conducted by field personnel and reviewed for accuracy by the LEA Task Manager and the QAM. All logs and documents will be checked for:

- General Completeness;
- Readability;
- Usage of appropriate procedures;
- Appropriate instrument calibration and maintenance;
- Reasonableness in comparison to present and past data collected;
- Correct sample locations; and
- Corrected calculations and interpretations.

5.8.3 Laboratory Data Reduction

The calculations used for data reduction are specified in each of the analytical methods referenced previously. Whenever possible, analytical data is transferred directly from the instrument to a computerized data system. Raw data is entered into permanently bound laboratory notebooks. The data entered are sufficient to document all factors used to arrive at the reported value.

Concentration calculations for chromatographic analyses (as for example, PCBs, VOCs) are based on response factors. Quantitation is performed using internal or external standards.

5.8.4 Laboratory Data Review

All data will be subject to review by the laboratory. The group leader will review all data reports prior to release for final data report generation. The QAM will review a random sample of a minimum 5 percent of the final data reports, and laboratory director will review a cross-section of the final data reports.

If discrepancies exist in the analytical results, then corrective action is taken as discussed in Section 5.11.

5.8.5 Laboratory Data Reporting

The laboratory is responsible for preparing standard laboratory reports for all samples analyzed.

Data will be tabulated by sample and method, with reference to both field and laboratory identifications. In addition, the laboratory will provide documentation backup (laboratory calculation sheets, chain of custody, etc.)

5.9 Field and Laboratory Quality Control Checks

5.9.1 General

Both field and laboratory quality control checks will be implemented during the RA. If a failure in the established sampling protocol occurs before the sample is collected, the field personnel shall use professional judgment to determine the location of an appropriate replacement sample. This alternative sample location will be documented in the field forms, and the information as to the reason for and location of the alternative sampling will be reported to the LEA Project Manager or designated person. If a failure in the established sampling protocol occurs after sample submission (for example, if part of the complete sample set is found to be inadmissible), the Project Manager will determine the location of replacement samples and collection methodology. The proposed field and laboratory control checks are discussed below.

5.9.2 Field Quality

Field quality control checks will include obtaining duplicate field measurements, using analyte-free water for the preparation of sample blanks, using clean sample containers, collecting duplicate samples, and preparing rinse blanks, as further described in the subsections below.

5.9.3 Field Measurements

To verify the quality of data using field instrumentation, duplicate measurements will be obtained and reported for all field measurements.

5.9.4 Sample Containers

Certified-clean sample containers will be supplied by analytical laboratory. Certificates of analysis will be filed in the project file.

5.9.5 Field Duplicates

Field duplicates will be collected for soil/sediment samples to verify the reproducibility of the sampling methods. Field duplicates will be prepared as discussed in the FSP. In general, soil and soil/sediment sample field duplicates will be analyzed at a frequency of one every 20 samples for chemical constituents. Table 4-2 provides an estimated number of field duplicates to be prepared for each applicable parameter and matrix. Acceptable field duplicate precision for soil samples must be less than 50%. Data that do not meet the criteria will be qualified according to USEPA Region I, Data Validation Guidelines, revised December 1996.

5.9.6 Equipment Blanks

Equipment blanks are used to monitor the cleanliness of sampling equipment and the effectiveness of the decontamination procedures. Equipment blanks will be prepared and submitted for analysis at a frequency of one every 20 samples. Equipment blanks will be prepared by filling sample containers with analyte free water, which has been routed through a cleaned sampling device. If dedicated sampling devices are used or sample containers are used to collect the samples, rinse blanks will not be required. Table 4-2 provides the estimated number of equipment blanks for environmental samples to be collected. The criterion for equipment blanks is such that no target compound should be present at or above the

laboratory quantitation limit. Data that do not meet the criteria will be qualified using the 5X action rule according to USEPA Region I Data Validation Guidelines, Revisions December 1996.

5.9.7 Method Blanks

Sources of contamination in the analytical process, whether specific analytes or interferences, need to be identified, isolated, and corrected. The method blank is useful in identifying possible sources of contamination within the analytical process. For this reason, it is necessary that the method blank is initiated at the beginning of the analytical process and encompasses all aspects of the analytical work. As such, the method blank would assist in accounting for potential contamination attributable to glassware, reagents, instrumentation, or other sources, which could affect the sample analysis. One method blank will be analyzed with each analytical series associated with no more than 20 samples. The criterion for method blanks is such that no target compound should be present at or above the laboratory quantitation limit. Data that do not meet the criteria will be qualified using the 5X action rule (10X rule for common laboratory contaminants) according to USEPA Region I Data Validation Guidelines, Revisions December 1996.

5.9.8 Matrix Spike/Matrix Spike Duplicates

MS/MSD will be used to measure the accuracy of organic analyte recovery from sample matrices. All MS/MSD will be site specific. For PCBs, metals, VOCs, SVOCs, and cyanide matrix spike/matrix spike duplicate pairs will be analyzed at a frequency of one every 20 samples.

The percent recovery (%R) and the relative percent difference (RPD) will be evaluated for MS/MSD data and compared with the acceptance criteria as stated in the appropriate EPA analytical method. When MS recoveries and RPDs are outside QC limits, associated MS blank and surrogate recoveries will be evaluated to attempt to verify the reason for deviation and determine the effects on the reported sample results. In addition, the percent relative standard deviation (%RSD) will be calculated for the unspiked sample, the MS and the MSD and will be considered a triplicate in determining overall precision of the analytical method. The unspiked sample results will be qualified according to the to USEPA Region I Data Validation Guidelines, Revisions December 1996 for any data that is outside acceptable control limits. Table 4-2 presents the estimated number of MS/MSD analyses for each applicable matrix and parameter.

5.9.9 Surrogate Blanks

Surrogates are compounds, which are unlikely to occur under natural conditions that have properties similar to the analytes of interest. This type of control is primarily used for organic samples analyzed by GC/MS and GC methods and is added to the sample prior to extraction. The surrogate spike is utilized to provide broader insight into the proficiency and efficiency of an analytical method on a spike specific basis.

If surrogate blank recoveries exceed specified QC limits, then the analytical results need to be evaluated thoroughly in conjunction with other control measures. Recoveries for surrogate compounds in samples, QC samples and blanks must be within the QC acceptance criteria as specified in the appropriate EPA analytical method. Samples with surrogate compounds outside acceptance will be qualified according to USEPA Region I Data Validation Guidelines, Revisions December 1996. Surrogate blank compounds will be selected utilizing the guidance provided in the analytical methods summarized in Table 5-1.

5.9.10 Calibration Standards

Compliance requirements for initial calibration are established to ensure that the instrument is capable of producing acceptable qualitative and quantitative data. Calibration check standards will be analyzed as specified in the applicable analytical method. In analyses where internal standards are used, a calibration check standard will only be analyzed in the beginning of an analytical series. If the results of the calibration check standard exceeds specified tolerances, then all samples analyzed since the last acceptable calibration check standard will be re-analyzed.

Laboratory instrument calibration standards will be selected utilizing the guidance provided in the analytical methods summarized in Table 5-1. Calibration data will be evaluated based on USEPA Region I Data Validation Guidelines, Revisions December 1996. Data that does not meet acceptance criteria will be qualified accordingly.

5.9.11 Internal Standards

Instrument performance, stability and laboratory precision throughout an analytical sequence is monitored by the addition of internal standard compounds. Internal standard areas and retention times are monitored for organic analysis performed by GC/MS methods. Method specific internal standard compounds are spikes into all field samples, calibration standards and QC samples after preparation and prior to analysis. If the internal standard areas in one or more samples exceed the specified tolerances, then the instrument will be recalibrated and all affected samples reanalyzed.

The acceptability of internal standard performance will be determined using the guidance provided within the analytical methods summarized in Table 5-1. Sample results with internal standard areas and/or retention time data outside control limits will be qualified based on USEPA Region I Data Validation Guidelines, Revisions December 1996.

5.9.12 Reference Standards

Reference standards are standards of known concentration, and independent in origin from the calibration standards. Reference standards, are generally available through the USEPA, the National Bureau of Standards, or are specified in analytical methods. The intent of reference standard analysis is to provide insight into the analytical proficiency within an analytical series.

5.9.13 Performance Evaluation Program

Performance Evaluation Audit

Data for performance evaluation samples will be generated to provide information on the overall accuracy and bias of the analytical method and on laboratory performance. UTC/P&W will conduct a performance evaluation (PE) audit as part of the program following "USEPA Region I Performance Evaluation Program Guidance," July 1996 Revision. Based upon the criteria presented in Attachment H of the USEPA Region I PE program guidance document, only aqueous PE samples will be submitted for this program. An overview of the proposed PE audit program is as follows:

- LEA will coordinate PE sample acquisition with the selected vendor prior to initiating the RA program;
- Sample acquisition, handling, and analyses will be in general accordance with USEPA Region 1 guidance criteria; and

- It is estimated that a total of four PE soil samples will be submitted as part of the program;

All samples in a sample delivery group will be validated based upon a comparison between the vendor-certified performance evaluation (PE) results and the laboratory's reported results. PE samples will be evaluated for false negatives, false positives, and inaccurate target compound quantitation. The PE samples provide information on the magnitude and direction of quantitative bias for the laboratory method. Results that are outside the vendor-certified acceptance limits will be qualified according to USEPA Region I Data Validation Guidelines, Revisions December 1996.

5.10 Performance and System Audits

5.10.1 General

This section describes the performance and system audits that will be completed in the field and the laboratory during implementation of RA.

5.10.2 Audits

Field performance and systems audits that will be completed during this project are described in the subsection below. The results of all audits and reviews, along with recommendations for corrective action, will be given to the LEA Project Manager as soon as possible in order to assess the need for any corrective action.

Readiness Reviews

Readiness reviews will be conducted prior to commencing each phase of the project on an as-needed basis to ensure all components required for each phase are in place.

Surveillance

Surveillance of remedial activities will be conducted by the LEA Task Manager or other field personnel on-site on a daily basis. Activities should be documented in the field notes. Any deviations from the FSP or QAPP should be reported to the Project Manager as soon as possible.

Technical System Audit

A Technical System Audit (TSA) shall be performed by the LEA Project Manager or person designated by the Project Manager shortly after commencing remedial activities. The purpose of the TSA is to ensure that facilities, personnel, training, procedures and record keeping are in accordance with the QAPP. Performing this early in the project provides opportunity for corrective action.

Audit of Data Quality

An audit of data quality will be performed by the management team prior to final reporting. This will serve to reveal how the data were handled, what judgments were made, and whether uncorrected mistakes were made.

5.10.3 Performance Audits

The LEA Task Manager will monitor field performance. Field performance audit summaries will contain an evaluation of field measurements and field meter calibration to verify that measurements are taken

according to established protocols. The QAM will review all field reports and communicate concerns to the Project Manager and/or Task Managers.

5.10.4 Internal System Audits

A field internal system audit is a qualitative evaluation of all components of field QA/QC. The system audit compares scheduled QA/QC activities from this document with actual QA/QC activities completed.

5.10.5 Laboratory Audits

The analytical laboratory will perform internal audits consistent with applicable regulations. LEA reserves the right to conduct an on site audit of the laboratory prior to start of analyses for the project.

5.11 Data Assessment Procedures

The analytical data generated during the RA will be evaluated with respect to precision, accuracy, and completeness and compared to the data quality objectives set forth in this QAPP. A summary of QC limits required to evaluate analytical performance is provided in Tables 5-2 and 5-3.

Following the collection of field sampling and analytical data, various statistical analyses can be performed to determine the data usability and sensitivity of the data.

Data usability can be checked through standard data validation procedures, and statistical cross validation procedures. These procedures involve predicting a data value for one point, based on results from other points. The difference between the measured and predicted number can indicate an invalid result.

An assessment of data sufficiency involves the determination of whether the confidence intervals values are rigorous enough to satisfy regulatory or engineering requirements.

5.11.1 Data Precision Assessment Procedures

Field precision will be controlled through the use of experienced field personnel, properly calibrated instruments, and duplicate field measurements. Field duplicates will be used to assess precision for the entire measurement system, including sampling, handling, shipping, storage, preparation, and analysis.

Laboratory data precision analyses will be monitored through the use of matrix spike/matrix spike duplicate sample analyses and performance evaluation samples. The precision of data will be measured by calibration of the relative percent difference (RPD) by the following equation:

$$RPD = \frac{(A-B)}{A+B/2} \times 100$$

Where:

A = Analytical results from first duplicate measurement

B = Analytical results from second duplicate measurement.

5.11.2 Data Accuracy Assessment Procedures

The accuracy of field precision will be controlled by experienced field personnel, properly calibrated field instruments, and adherence to established protocols. The accuracy of field instruments will be assessed by review of calibration and maintenance logs.

Laboratory accuracy will be assessed via the use of matrix spike, surrogate spikes, PE samples, and reference standards. Where available and appropriate, QA performance standards will be analyzed periodically to assess laboratory accuracy. Accuracy will be calculated in terms of percent recovery as follows:

$$\text{Percent Recovery} = \frac{(A-X)}{B} \times 100$$

Where:

A = Value measured in spiked sample

X = Value measured in original sample

B = True value of amount added to sample or true value of standard.

This formula is derived under the assumption of constant accuracy between the original and spiked measurements. Accuracy objectives for matrix spike recoveries are found in Tables 5-2 and 5-3.

5.11.3 Data Completeness Assessment Procedures

Completeness of field or laboratory data set will be calculated by comparing the number of valid sample results generated to the total number of results generated:

$$\text{Completeness} = \frac{\text{Number of Valid Results}}{\text{Total Number of Results Generated}} \times 100$$

As a general guideline, overall project completeness is expected to be at least 90%. The assessment of completeness will require professional judgment to determine data usability for intended purposes.

5.11.4 Internal Reporting

The QAM will review analytical concerns identified by the data review with the laboratory. Supporting data (i.e. historic data, related field or laboratory data) will be reviewed to assist in determining data quality, as appropriate. The QAM will incorporate results of assessments of data usability into a summary that will be submitted to the Project Manager and appropriate Task Managers.

5.11.5 RA Reporting

The summary report prepared by LEA will contain a QA/QC section summarizing the quality of data collected and/or used as appropriate to the project data quality objectives, which are discussed in this QAPP. The QAM will prepare the QA/QC summaries using reporting and memoranda documenting the data assessment and review.

5.11.6 Data Validation

A standardized data validation review process for judging the analytical quality and usefulness of data will be performed in accordance with the procedures set forth in the most current editions of the USEPA Region I Laboratory Data Validation Functional Guidelines for Evaluating Environmental Analyses. Technical judgment on the validity of the laboratory results will be provided to determine the overall usability and legal defensibility. All confirmatory sample data obtained will be validated. Individual sample results will be either accepted, rejected, or qualified. Validation decisions will be communicated to the end-user through a written data validation memorandum and all qualifiers applied to the individual sample results will be incorporated into the analytical database.

The following items will be reviewed:

- Data Completeness;
- Custody Documentation;
- Preservation and Holding Times;
- Instrument Performance
- Initial and Continuing Calibration
- Calibration Standards;
- Blanks
- Field Duplicate Precision
- Surrogate and Internal Standard Recoveries;
- Matrix Spike Recoveries/Duplicate Correlations;
- Control Spike/Laboratory Control Spike;
- Performance Evaluation Assessment
- Instrument Detection Limits (IDLs);
- Method Compliance; and
- Sample Result Verification.
- Overall Evaluation of Data

Project requirements are for full validation of 20% of the field samples within each data package.

5.12 Reports to Management.

Daily reports on remedial activities (verbal or written) will be given from field personnel to the LEA Project Manager or person designated by the Project Manager.

Laboratory reports will be given to the Project Manager as received.

Memorandums regarding data validation will be provided to the Project Manager after complete review of the laboratory data package by the data validation staff.

TABLES

Table 4-1**Willow Brook and Willow Brook Pond
East Hartford, Connecticut****Field Sampling Plan
Confirmatory Sampling Summary**

Sample Type	Sample Media	Anticipated Number of Samples	Laboratory Analytical Methods (USEPA SW-846)
Confirmatory	Soil/Sediment	65	8082A, Rev. January, 1988 (PCB) 8260B Rev. January 1995 (VOC) 8270C Rev. January 1995 (SVOC) 1312 Rev. September 1994 (SPLP) 6010B Rev. December 1996 (ICP Metals) 7010 Rev. January 1998 (GFAA Metals) 7471B Rev. January 1998 (Mercury–Cold Vapor) 9010 Rev. December 1996 (Cyanide)
Disposal/ Characterization	Soil/Sediment	24	8082A, Rev. January, 1988 (PCB) 8260B Rev. January 1995 (VOC) 8270C Rev. January 1995 (SVOC) 1312 Rev. September 1994 (SPLP) 6010B Rev. December 1996 (ICP Metals) 7010 Rev. January 1998 (GFAA Metals) 7471B Rev. January 1998 (Mercury–Cold Vapor) 9010 Rev. December 1996 (Cyanide)
Temporary Wastewater Treatment System Effluent	Wastewater	As Required By Permit	As Required By Permit

Notes

1. Bottom samples are collected at a frequency of 1 sample per every 400 square feet of excavation bottom.
2. Samples are collected from an interval of 0 to 6 inches below post-remediation surface.
3. PCB = Polychlorinated Biphenyls
SVOC = Semi-Volatile Organic Compounds
VOC = Volatile Organic Compounds
SPLP = Synthetic Precipitate Leachate Procedure
ICP = Inductively Coupled Plasma
GFAA = Graphite Furnace Atomic Absorption Spectrometry
4. USEPA = United States Environmental Protection Agency

Table 4-2

**Willow Brook and Willow Brook Pond
East Hartford, Connecticut**

**Field Sampling Plan
Quality Control Analyses Summary**

Environmental Sample Matrix / Laboratory Parameters	Estimated Environmental Sample Quantity (Solid)	Field QC Analyses						Estimated Number of Field Samples	Laboratory QC Analyses								Estimated Overall Total
		Trip Blank (Aqueous)		Field Duplicate (Solid)		Equipment Blank ^a (Aqueous)			MS ^a (Solid)		MSD ^a (Solid)		SB ^a (Solid)		PE Sample (Aqueous)		
		Freq.	No.	Freq.	No.	Freq.	No.		Freq.	No.	Freq.	No.	Freq.	No.	Freq.	No.	
Post-Excavation Confirmation Sediment/Soil Samples																	
PCB, SVOC, VOC, Metals, Cyanide	65	1/Day	30	1/20	4	1/20	4	103	1/20	4	1/20	4	1/20	4	1/20	4	119

Notes:

1. Table assumes that samples will be processed in groups of 20 samples for QC analyses. If smaller sample groups are processed, the one MS/MSD (or MS/laboratory dup) per sample delivery group (up to 20 samples) will be prepared for each sample delivery group.
2. ^a = These field and laboratory QC analysis shall be performed at a frequency of 1/20 or 1/week, whichever comes first. Table assumes samples will be collected at a rate of 20 samples per week.
3. QA/QC samples will not be collected for confirmation soil samples, confirmation sediment samples, or water samples from the temporary on-site water treatment system.
4. PCB = Polychlorinated Biphenyls.
SVOC = Semi-Volatile Organic Compounds
VOC = Volatile Organic Compounds

MS, MSD, SB, and PE

MS = Matrix Spike
MSD = Matrix Spike Duplicate
SB = Surrogate Blank
PE = Performance Evaluation Sample

Table 4-3
Required Containers, Preservatives, and Analysis
Holding Times for Solid, Aqueous, and Vapor Samples

Fraction	Soil/Solid Sample Bottle	Preservative	Holding Time
TCL Volatiles	1-4 oz. glass w/Teflon lined enclosure	Cool to 4 C.	14 days
TCL Semivolatiles	1-16 oz. glass w/Teflon lined enclosure.	Cool to 4 C.	14 days till extraction/40 days to inject extract
TCL Organochlorine Pesticides/PCBs	from same 16 oz. above	Cool to 4 C.	14 days till extraction/40 days to inject extract
chloride, sulfate, ammonia, COD alkalinity	from same 16 oz. above	Cool to 4 C.	28 days 14 days
nitrate, nitrite, o-phosphate, BOD	from same 16 oz. above	Cool to 4 C.	48 hours
hexavalent chromium	from same 16 oz. above	Cool to 4 C.	48 hours
TAL metals plus Tin	from same 16 oz. above	Cool to 4 C.	28 days Hg & 180 days all other metals
Cyanides	from same 4 oz. above	Cool to 4 C.	14 days
Dioxins	1-4 oz. glass w/Teflon lined enclosure.	Cool to 4 C.	30 days till extraction/45 days to complete analysis
TOC	from same 16 oz. above	Cool to 4 C.	28 days
Trip Blank, Field Blank or Aqueous Sample			
TCL Volatiles	2-40 ml glass screw cap vials with Teflon septa	HCl to pH <2, Cool to 4 C.	14 days
TCL Semivolatiles	2-1 liter amber glass with Teflon lined cap	Cool to 4 C.	7 days extraction/40 days to inject
TCL Organochlorine Pesticides/PCBs	2-1 liter amber glass with Teflon lined cap	Cool to 4 C.	7 days extraction/40 days to inject
TAL Metals plus Tin	1-1 liter HDP	HNO to pH<2	28 days Hg & 180 days all other metals
Cyanides	1-1 liter HDP	NaOH to pH >12, Cool to 4 C.	14 days
Dioxins	2-1 liter amber glass with Teflon lined cap	Cool to 4 C.	30 days extraction/45 days to complete analysis
Chloride, sulfate TDS, TSS alkalinity	1-1 liter HDP	Cool to 4 C.	28 days 7 days 14 days
nitrate, nitrite, o-phosphate, BOD	1-1 liter HDP	Cool to 4 C.	48 hours
hexavalent chromium	1-500 ml HDP	Cool to 4 C.	24 hours
ammonia, COD	1-1 liter clear glass with Teflon lined cap	HSO to pH<2, Cool to 4 C.	28 days
TOC	1-125 ml glass with Teflon lined cap	HSO to pH<2, Cool to 4 C.	28 days
Fraction	Air Sample Container/Media	Preservative	Holding Time
TCL Volatiles	SUMMA Canister	None	14 days
TCL Semivolatiles	XAD-2/PUF Cartridges	Cool to 4 C	14 days extraction/40 days to inject
TAL Metals plus Tin	Quartz Filter	None	28 days Hg & 180 days all other metals
Total Suspended Particulate Matter	Quartz Filter	None	14 days

NOTES:

1 - Depending on how sample analyses are distributed between the laboratories, additional sample bottles may be required.

2 - Holding times are from the date of sample collection.

Table 5-1
PROJECT SPECIFIC PRACTICAL QUANTITATION LIMITS FOR CONSTITUENTS
FOR WHICH ANALYSIS MAY BE CONDUCTED

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CAS#	Analyte Name	Type	Project Quantitation Limits				
			Method	Aqueous	Units	Soil	Units
67-64-1	Acetone	VOA	SW846-8260A	100.0	ug/l	100.0	ug/kg
75-05-8	Acetonitrile	VOA	SW846-8260A	100.0	ug/l	100.0	ug/kg
107-02-8	Acrolein	VOA	SW846-8260A	5.0	ug/l	100.0	ug/kg
107-13-1	Acrylonitrile	VOA	SW846-8260A	0.5	ug/l	10.0	ug/kg
107-05-1	Allyl chloride	VOA	SW846-8260A	100.0	ug/l	100.0	ug/kg
71-43-2	Benzene	VOA	SW846-8260A	1.0	ug/l	5.0	ug/kg
75-27-4	Bromodichloromethane	VOA	SW846-8260A	5.0	ug/l	5.0	ug/kg
75-25-2	Bromoform	VOA	SW846-8260A	4.0	ug/l	5.0	ug/kg
74-83-9	Methyl bromide (bromomethane)	VOA	SW846-8260A	10.0	ug/l	10.0	ug/kg
78-93-3	Methyl ethyl ketone (2-Butanone)	VOA	SW846-8260A	100.0	ug/l	100.0	ug/kg
75-15-0	Carbon disulfide	VOA	SW846-8260A	5.0	ug/l	5.0	ug/kg
56-23-5	Carbon tetrachloride	VOA	SW846-8260A	5.0	ug/l	5.0	ug/kg
108-90-7	Chlorobenzene	VOA	SW846-8260A	5.0	ug/l	5.0	ug/kg
75-00-3	Chloroethane	VOA	SW846-8260A	10.0	ug/l	10.0	ug/kg
67-66-3	Chloroform	VOA	SW846-8260A	5.0	ug/l	5.0	ug/kg
126-99-8	Chloroprene	VOA	SW846-8260A	5.0	ug/l	5.0	ug/kg
74-87-3	Methyl chloride (Chloromethane)	VOA	SW846-8260A	10.0	ug/l	10.0	ug/kg
124-48-1	Dibromochloromethane	VOA	SW846-8260A	0.5	ug/l	5.0	ug/kg
96-12-8	1,2-Dibromo-3-chloropropane	VOA	SW846-8260A	5.0	ug/l	5.0	ug/kg
74-95-3	Dibromomethane (methylene bromide)	VOA	SW846-8260A	5.0	ug/l	5.0	ug/kg
106-93-4	Ethylene dibromide (EDB)	VOA	SW846-8260A	0.5	ug/l	5.0	ug/kg
110-57-6	trans-1,4-Dichloro-2-butene	VOA	SW846-8260A	5.0	ug/l	5.0	ug/kg
75-71-8	Dichlorodifluoromethane	VOA	SW846-8260A	5.0	ug/l	5.0	ug/kg
75-34-3	1,1-Dichloroethane	VOA	SW846-8260A	5.0	ug/l	5.0	ug/kg
107-06-2	1,2-Dichloroethane	VOA	SW846-8260A	1.0	ug/l	5.0	ug/kg
75-35-4	1,1-Dichloroethene	VOA	SW846-8260A	1.0	ug/l	5.0	ug/kg
156-59-2	cis-1,2-Dichloroethene	VOA	SW846-8260A	5.0	ug/l	5.0	ug/kg
156-60-5	trans-1,2-Dichloroethene	VOA	SW846-8260A	5.0	ug/l	5.0	ug/kg
78-87-5	1,2-Dichloropropane	VOA	SW846-8260A	5.0	ug/l	5.0	ug/kg
542-75-6	1,3-Dichloropropene (total)	VOA	SW846-8260A	0.5	ug/l	5.0	ug/kg
123-91-1	1,4-Dioxane	VOA	SW846-8260A	150.0	ug/l	150.0	ug/kg
100-41-4	Ethylbenzene	VOA	SW846-8260A	5.0	ug/l	5.0	ug/kg
97-63-2	Ethyl methacrylate	VOA	SW846-8260A	5.0	ug/l	5.0	ug/kg
591-78-6	2-Hexanone	VOA	SW846-8260A	50.0	ug/l	50.0	ug/kg
78-83-1	Isobutyl alcohol	VOA	SW846-8260A	50.0	ug/l	50.0	ug/kg
126-98-7	Methacrylonitrile	VOA	SW846-8260A	5.0	ug/l	5.0	ug/kg
75-09-2	Methylene chloride	VOA	SW846-8260A	5.0	ug/l	5.0	ug/kg
74-88-4	Methyl iodide	VOA	SW846-8260A	5.0	ug/l	5.0	ug/kg
80-62-6	Methyl methacrylate	VOA	SW846-8260A	5.0	ug/l	5.0	ug/kg
108-10-1	4-Methyl-2-pentanone	VOA	SW846-8260A	5.0	ug/l	5.0	ug/kg
1634-04-4	Methyl-tert-butyl ether	VOA	SW846-8260A	5.0	ug/l	5.0	ug/kg
107-12-0	Propionitrile	VOA	SW846-8260A	5.0	ug/l	5.0	ug/kg
100-42-5	Styrene	VOA	SW846-8260A	5.0	ug/l	5.0	ug/kg
630-20-6	1,1,1,2-Tetrachloroethane	VOA	SW846-8260A	1.0	ug/l	5.0	ug/kg
79-34-5	1,1,2,2-Tetrachloroethane	VOA	SW846-8260A	0.5	ug/l	5.0	ug/kg
127-18-4	Tetrachloroethene	VOA	SW846-8260A	5.0	ug/l	5.0	ug/kg
108-88-3	Toluene	VOA	SW846-8260A	5.0	ug/l	5.0	ug/kg
71-55-6	1,1,1-Trichloroethane	VOA	SW846-8260A	5.0	ug/l	5.0	ug/kg
79-00-5	1,1,2-Trichloroethane	VOA	SW846-8260A	5.0	ug/l	5.0	ug/kg
79-01-6	Trichloroethene	VOA	SW846-8260A	5.0	ug/l	5.0	ug/kg
75-69-4	Trichlorofluoromethane	VOA	SW846-8260A	5.0	ug/l	5.0	ug/kg

Table 5-1
PROJECT SPECIFIC PRACTICAL QUANTITATION LIMITS FOR CONSTITUENTS
FOR WHICH ANALYSIS MAY BE CONDUCTED

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CAS#	Analyte Name	Type	Project Quantitation Limits			
			Method	Aqueous	Units	Soil
108-05-4	Vinyl acetate	VOA	SW846-8260A	5.0	ug/l	5.0
96-18-4	1,2,3-Trichloropropane	VOA	SW846-8260A	5.0	ug/l	5.0
75-01-4	Vinyl chloride	VOA	SW846-8260A	2.0	ug/l	10.0
1330-20-7	Xylenes (total)	VOA	SW846-8260A	5.0	ug/l	5.0
83-32-9	Acenaphthene	SV	SW846-8270B	10	ug/l	330
208-96-8	Acenaphthylene	SV	SW846-8270B	0.3	ug/l	330
98-86-2	Acetophenone	SV	SW846-8270B	10	ug/l	330
53-96-3	2-Acetylaminofluorene	SV	SW846-8270B	10	ug/l	330
92-67-1	4-Aminobiphenyl	SV	SW846-8270B	10	ug/l	330
62-53-3	Aniline	SV	SW846-8270B	10	ug/l	330
120-12-7	Anthracene	SV	SW846-8270B	10	ug/l	330
140-57-8	Aramite	SV	SW846-8270B	10	ug/l	330
56-55-3	Benzo[a]anthracene	SV	SW846-8270B	0.6	ug/l	330
205-99-2	Benzo[b]fluoranthene	SV	SW846-8270B	0.08	ug/l	330
207-08-9	Benzo[k]fluoranthene	SV	SW846-8270B	0.3	ug/l	330
191-24-2	Benzo[ghi]perylene	SV	SW846-8270B	10	ug/l	330
50-32-8	Benzo[a]pyrene	SV	SW846-8270B	0.2	ug/l	330
100-51-6	Benzyl alcohol	SV	SW846-8270B	20	ug/l	670
111-91-1	bis(2-Chloroethoxy) methane	SV	SW846-8270B	10	ug/l	330
111-44-4	bis(2-Chloroethyl)ether	SV	SW846-8270B	10	ug/l	330
108-60-1	2,2'-oxybis(1-chloro-Propane)	SV	SW846-8270B	10	ug/l	330
117-81-7	bis(2-Ethylhexyl)phthalate	SV	SW846-8270B	2	ug/l	330
101-55-3	4-Bromophenyl phenyl ether	SV	SW846-8270B	10	ug/l	330
85-68-7	Butyl benzyl phthalate	SV	SW846-8270B	10	ug/l	330
86-74-8	Carbazole	SV	SW846-8270B	10	ug/l	330
106-47-8	4-Chloroaniline	SV	SW846-8270B	20	ug/l	670
59-50-7	4-Chloro-3-methyl phenol	SV	SW846-8270B	20	ug/l	670
91-58-7	2-Chloronaphthalene	SV	SW846-8270B	10	ug/l	330
95-57-8	2-Chlorophenol	SV	SW846-8270B	10	ug/l	330
7005-72-3	4-Chlorophenyl phenyl ether	SV	SW846-8270B	10	ug/l	330
218-01-9	Chrysene	SV	SW846-8270B	10	ug/l	330
132-64-9	Dibenzofuran	SV	SW846-8270B	10	ug/l	330
84-74-2	Di-n-butyl phthalate	SV	SW846-8270B	10	ug/l	330
117-84-0	Di-n-octyl phthalate	SV	SW846-8270B	10	ug/l	330
53-70-3	Dibenz[a,h]anthracene	SV	SW846-8270B	10	ug/l	330
95-50-1	1,2-Dichlorobenzene	SV	SW846-8270B	10	ug/l	330
541-73-1	1,3-Dichlorobenzene	SV	SW846-8270B	10	ug/l	330
106-46-7	1,4-Dichlorobenzene	SV	SW846-8270B	10	ug/l	330
91-94-1	3,3-Dichlorobenzidine	SV	SW846-8270B	20	ug/l	670
120-83-2	2,4-Dichlorophenol	SV	SW846-8270B	10	ug/l	330
84-66-2	Diethyl phthalate	SV	SW846-8270B	10	ug/l	330
297-97-2	0,0-Diethyl-0-2-pyrazinyl	SV	SW846-8270B	10	ug/l	330
60-51-5	Dimethoate	SV	SW846-8270B	10	ug/l	330
60-11-7	p-(Dimethylamino)azobenzene	SV	SW846-8270B	10	ug/l	330
57-97-6	7,12-Dimethylbenz(a)anthracene	SV	SW846-8270B	10	ug/l	330
122-09-8	alpha, alpha, -Dimethylphenethylamine	SV	SW846-8270B	10	ug/l	330
119-93-7	3,3-Dimethylbenzidine	SV	SW846-8270B	10	ug/l	330
105-67-9	2,4-Dimethylphenol	SV	SW846-8270B	10	ug/l	330
131-11-3	Dimethyl phthalate	SV	SW846-8270B	10	ug/l	330
99-65-0	1,3-Dinitrobenzene	SV	SW846-8270B	10	ug/l	330

Table 5-1
PROJECT SPECIFIC PRACTICAL QUANTITATION LIMITS FOR CONSTITUENTS
FOR WHICH ANALYSIS MAY BE CONDUCTED

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CAS#	Analyte Name	Type	Project Quantitation Limits				
			Method	Aqueous	Units	Soil	Units
534-52-1	4,6-Dinitro-2-methylphenol	SV	SW846-8270B	50	ug/l	830	ug/kg
51-28-5	2,4-Dinitrophenol	SV	SW846-8270B	50	ug/l	830	ug/kg
121-14-2	2,4-Dinitrotoluene	SV	SW846-8270B	10	ug/l	330	ug/kg
606-20-2	2,6-Dinitrotoluene	SV	SW846-8270B	10	ug/l	330	ug/kg
117-84-0	Di-n-octyl phthalate	SV	SW846-8270B	10	ug/l	330	ug/kg
88-85-7	Dinoseb	SV	SW846-8270B	10	ug/l	330	ug/kg
122-39-4	Diphenylamine	SV	SW846-8270B	10	ug/l	330	ug/kg
298-04-4	Disulfoton	SV	SW846-8270B	10	ug/l	330	ug/kg
65-50-0	Ethyl methanesulfonate	SV	SW846-8270B	10	ug/l	330	ug/kg
52-85-7	Famphur	SV	SW846-8270B	10	ug/l	330	ug/kg
206-44-0	Fluoranthene	SV	SW846-8270B	10	ug/l	330	ug/kg
86-73-7	Fluorene	SV	SW846-8270B	10	ug/l	330	ug/kg
118-74-1	Hexachlorobenzene	SV	SW846-8270B	0.077	ug/l	330	ug/kg
87-68-3	Hexachlorobutadiene	SV	SW846-8270B	10	ug/l	330	ug/kg
77-47-4	Hexachlorocyclopentadiene	SV	SW846-8270B	10	ug/l	330	ug/kg
67-72-1	Hexachloroethane	SV	SW846-8270B	3	ug/l	330	ug/kg
70-30-4	Hexachlorophene	SV	SW846-8270B	10	ug/l	330	ug/kg
1888-71-7	Hexachloropropene	SV	SW846-8270B	10	ug/l	330	ug/kg
193-39-5	Indeno(1,2,3-cd)pyrene	SV	SW846-8270B	10	ug/l	330	ug/kg
78-59-1	Isophorone	SV	SW846-8270B	10	ug/l	330	ug/kg
120-58-1	Isosafrole	SV	SW846-8270B	10	ug/l	330	ug/kg
91-80-5	Methapyrilene	SV	SW846-8270B	10	ug/l	330	ug/kg
56-49-5	3-Methylcholanthrene	SV	SW846-8270B	10	ug/l	330	ug/kg
66-27-3	Methyl methanesulfonate	SV	SW846-8270B	10	ug/l	330	ug/kg
91-57-6	2-Methylnaphthalene	SV	SW846-8270B	10	ug/l	330	ug/kg
95-48-7	2-Methylphenol (o-Cresol)	SV	SW846-8270B	10	ug/l	330	ug/kg
108-39-4	3-Methylphenol ((m-Cresol)	SV	SW846-8270B	10	ug/l	330	ug/kg
106-44-5	4-Methylphenol (p-Cresol)	SV	SW846-8270B	10	ug/l	330	ug/kg
298-00-0	Methyl parathion	SV	SW846-8270B	10	ug/l	330	ug/kg
91-20-3	Naphthalene	SV	SW846-8270B	10	ug/l	330	ug/kg
130-15-4	1,4-Naphthoquinone	SV	SW846-8270B	10	ug/l	330	ug/kg
134-32-7	1-Naphthylamine	SV	SW846-8270B	10	ug/l	330	ug/kg
91-59-8	2-Naphthylamine	SV	SW846-8270B	10	ug/l	330	ug/kg
88-74-4	2-Nitroaniline	SV	SW846-8270B	50	ug/l	830	ug/kg
99-09-2	3-Nitroaniline	SV	SW846-8270B	50	ug/l	830	ug/kg
100-01-6	4-Nitroaniline	SV	SW846-8270B	50	ug/l	830	ug/kg
98-95-3	Nitrobenzene	SV	SW846-8270B	10	ug/l	330	ug/kg
56-57-5	4-Nitroquinoline-1-oxide	SV	SW846-8270B	10	ug/l	330	ug/kg
88-75-5	2-Nitrophenol	SV	SW846-8270B	10	ug/l	330	ug/kg
100-02-7	4-Nitrophenol	SV	SW846-8270B	50	ug/l	830	ug/kg
55-18-5	N-Nitrosodiethylamine	SV	SW846-8270B	10	ug/l	330	ug/kg
62-75-9	N-Nitrosodimethylamine	SV	SW846-8270B	10	ug/l	330	ug/kg
86-30-6	N-Nitrosodiphenylamine	SV	SW846-8270B	10	ug/l	330	ug/kg
621-64-7	N-Nitrosodi-n-propylamine	SV	SW846-8270B	10	ug/l	330	ug/kg
924-16-3	N-Nitrosodi-n-butylamine	SV	SW846-8270B	10	ug/l	330	ug/kg
10595-95-6	N-Nitrosomethylethylamine	SV	SW846-8270B	10	ug/l	330	ug/kg
59-89-2	N-Nitrosomorpholine	SV	SW846-8270B	10	ug/l	330	ug/kg
100-75-4	N-Nitrosopiperidenemethylethylamine	SV	SW846-8270B	10	ug/l	330	ug/kg
930-55-2	N-Nitrosopyrrolidine	SV	SW846-8270B	10	ug/l	330	ug/kg
99-55-8	5-Nitro-0-toluidine	SV	SW846-8270B	10	ug/l	330	ug/kg
56-38-2	Parathion	SV	SW846-8270B	10	ug/l	330	ug/kg

Table 5-1
PROJECT SPECIFIC PRACTICAL QUANTITATION LIMITS FOR CONSTITUENTS
FOR WHICH ANALYSIS MAY BE CONDUCTED

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CAS#	Analyte Name	Type	Project Quantitation Limits			
			Method	Aqueous	Units	Soil
608-93-5	Pentachlorobenzene	SV	SW846-8270B	10	ug/l	330
76-01-7	Pentachloroethane	SV	SW846-8270B	10	ug/l	330
82-68-8	Pentachloronitrobenzene	SV	SW846-8270B	10	ug/l	330
87-86-5	Pentachlorophenol	SV	SW846-8270B	1	ug/l	830
62-44-2	Phenacetin	SV	SW846-8270B	10	ug/l	330
85-01-8	Phenanthrene	SV	SW846-8270B	0.077	ug/l	330
108-95-2	Phenol	SV	SW846-8270B	10	ug/l	330
106-50-3	p-Phenylenediamine	SV	SW846-8270B	10	ug/l	330
298-02-2	Phorate	SV	SW846-8270B	10	ug/l	330
109-06-8	2-Picoline	SV	SW846-8270B	10	ug/l	330
23950-58-5	Pronamide	SV	SW846-8270B	10	ug/l	330
129-00-0	Pyrene	SV	SW846-8270B	10	ug/l	330
110-86-1	Pyridine	SV	SW846-8270B	10	ug/l	330
94-59-7	Safrole	SV	SW846-8270B	10	ug/l	330
3689-24-5	Sulfotepp	SV	SW846-8270B	10	ug/l	330
95-94-3	1,2,4,5-Tetrachlorobenzene	SV	SW846-8270B	10	ug/l	330
58-90-2	2,3,4,6-Tetrachlorophenol	SV	SW846-8270B	10	ug/l	330
95-53-4	0-Toluidine	SV	SW846-8270B	10	ug/l	330
120-82-1	1,2,4-Trichlorobenzene	SV	SW846-8270B	10	ug/l	330
95-95-4	2,4,5-Trichlorophenol	SV	SW846-8270B	10	ug/l	330
88-06-2	2,4,6-Trichlorophenol	SV	SW846-8270B	10	ug/l	330
126-68-1	0,0,0-Triethylphosphorothioate	SV	SW846-8270B	10	ug/l	330
99-35-4	1,3,5-Trinitrobenzene	SV	SW846-8270B	10	ug/l	330
15972-60-8	Alachlor	OCP	SW846-8080A	2	ug/l	230.0
116-06-3	Aldicarb	OCP	SW846-8080A	3	ug/l	1000.0
309-00-2	Aldrin	OCP	SW846-8080A	0.05	ug/l	1.7
1912-24-9	Atrazine	OCP	SW846-8080A	3	ug/l	200.0
319-84-6	alpha-BHC	OCP	SW846-8080A	0.05	ug/l	1.7
319-85-7	beta-BHC	OCP	SW846-8080A	0.05	ug/l	1.7
319-86-8	delta-BHC	OCP	SW846-8080A	0.05	ug/l	1.7
58-89-9	gamma-BHC/Lindane	OCP	SW846-8080A	0.05	ug/l	1.7
57-74-9	Chlordane	OCP	SW846-8080A	0.05	ug/l	1.7
94-75-7	2,4-D	OCP	SW846-8080A	70	ug/l	1400.0
72-54-8	4,4-DDD	OCP	SW846-8080A	0.1	ug/l	3.3
72-55-9	4,4-DDE	OCP	SW846-8080A	0.1	ug/l	3.3
50-29-3	4,4-DDT	OCP	SW846-8080A	0.1	ug/l	3.3
60-57-1	Dieldrin	OCP	SW846-8080A	0.002	ug/l	3.3
959-98-8	Endosulfan I	OCP	SW846-8080A	0.05	ug/l	1.7
33213-65-9	Endosulfan II	OCP	SW846-8080A	0.1	ug/l	3.3
1031-07-8	Endosulfan sulfate	OCP	SW846-8080A	0.1	ug/l	3.3
72-20-8	Endrin	OCP	SW846-8080A	0.1	ug/l	3.3
7421-93-4	Endrin aldehyde	OCP	SW846-8080A	0.1	ug/l	3.3
53494-70-5	Endrin ketone	OCP	SW846-8080A	0.1	ug/l	3.3
76-44-8	Heptachlor	OCP	SW846-8080A	0.05	ug/l	1.7
1024-57-3	Heptachlor epoxide	OCP	SW846-8080A	0.05	ug/l	1.7
72-43-5	Methoxychlor	OCP	SW846-8080A	0.5	ug/l	17.0
122-34-9	Simazine	OCP	SW846-8080A	4	ug/l	800.0
8001-35-2	Toxaphene	OCP	SW846-8080A	1.0	ug/l	170
12674-11-2	Aroclor-1016	OCP	SW846-8080A	0.5	ug/l	33

Table 5-1
PROJECT SPECIFIC PRACTICAL QUANTITATION LIMITS FOR CONSTITUENTS
FOR WHICH ANALYSIS MAY BE CONDUCTED

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CAS#	Analyte Name	Type	Project Quantitation Limits				
			Method	Aqueous	Units	Soil	Units
11104-28-2	Aroclor-1221	OCP	SW846-8080A	0.5	ug/l	67	ug/kg
11141-16-5	Aroclor-1232	OCP	SW846-8080A	0.5	ug/l	33	ug/kg
53469-21-9	Aroclor-1242	OCP	SW846-8080A	0.5	ug/l	33	ug/kg
12672-29-6	Aroclor-1248	OCP	SW846-8080A	0.5	ug/l	33	ug/kg
11097-69-1	Aroclor-1254	OCP	SW846-8080A	0.5	ug/l	33	ug/kg
11096-82-5	Aroclor-1260	OCP	SW846-8080A	0.5	ug/l	33	ug/kg
7440-36-0	Antimony	M	SW846-6010A	6	ug/l	12	mg/kg
7440-38-2	Arsenic	M	SW846-7000A	4	ug/l	1	mg/kg
7440-39-3	Barium	M	SW846-6010A	200	ug/l	15	mg/kg
7440-41-7	Beryllium	M	SW846-6010A/7000A	4	ug/l	0.08	mg/kg
7440-43-9	Cadmium	M	SW846-7000A	5	ug/l	0.1	mg/kg
7440-47-3	Chromium (total)	M	SW846-6010A	10	ug/l	1	mg/kg
7440-48-4	Cobalt	M	SW846-6010A	50	ug/l	8	mg/kg
7440-50-8	Copper	M	SW846-6010A	25	ug/l	6	mg/kg
7439-92-1	Lead	M	SW846-7000A	3	ug/l	0.3	mg/kg
7439-97-6	Mercury	M	SW846-7470A/7471A	0.2	ug/l	0.15	mg/kg
7440-02-0	Nickel	M	SW846-6010A	40	ug/l	0.9	mg/kg
7782-49-2	Selenium	M	SW846-6010A/7000A	5	ug/l	0.8	mg/kg
7440-22-4	Silver	M	SW846-6010A	10	ug/l	3	mg/kg
7440-28-0	Thallium	M	SW846-7000A	5	ug/l	3	mg/kg
7440-31-5	Tin	M	SW846-6010A	250	ug/l	20	mg/kg
7440-62-2	Vanadium	M	SW846-6010A	50	ug/l	1	mg/kg
7440-66-6	Zinc	M	SW846-6010A	20	ug/l	15	mg/kg
7429-90-5	Aluminum	M	SW846-6010A	200	ug/l	46	mg/kg
7440-70-2	Calcium	M	SW846-6010A	5000	ug/l	76	mg/kg
7439-89-6	Iron	M	SW846-6010A	100	ug/l	30	mg/kg
7439-95-4	Magnesium	M	SW846-6010A	5000	ug/l	38	mg/kg
7439-96-5	Manganese	M	SW846-6010A	15	ug/l	3	mg/kg
7440-09-7	Potassium	M	SW846-6010A	5000	ug/l	76	mg/kg
7440-23-5	Sodium	M	SW846-6010A	5000	ug/l	76	mg/kg
7440-36-0	Antimony - SPLP/TCLP	M	1311/1312-6010A	N/A	N/A	0.006	mg/l
7440-38-2	Arsenic - SPLP/TCLP	M	1311/1312-7000A	N/A	N/A	0.05	mg/l
7440-39-3	Barium - SPLP/TCLP	M	1311/1312-6010A	N/A	N/A	1	mg/l
7440-41-7	Beryllium - SPLP/TCLP	M	1311/1312-6010A	N/A	N/A	0.004	mg/l
7440-43-9	Cadmium - SPLP/TCLP	M	1311/1312-6010A	N/A	N/A	0.005	mg/l
7440-47-3	Chromium (total) - SPLP/TCLP	M	1311/1312-6010A	N/A	N/A	0.05	mg/l
7440-50-8	Copper - SPLP/TCLP	M	1311/1312-6010A	N/A	N/A	1.3	mg/l
7439-92-1	Lead - SPLP/TCLP	M	1311/1312-7000A	N/A	N/A	0.015	mg/l
7439-97-6	Mercury - SPLP/TCLP	M	1311/1312-7470	N/A	N/A	0.002	mg/l
7440-02-0	Nickel - SPLP/TCLP	M	1311/1312-6010A	N/A	N/A	0.1	mg/l
7782-49-2	Selenium - SPLP/TCLP	M	1311/1312-7000A	N/A	N/A	0.05	mg/l
7440-22-4	Silver - SPLP/TCLP	M	1311/1312-6010A	N/A	N/A	0.036	mg/l
7440-28-0	Thallium SPLP/TCLP	M	1311/1312-7000A	N/A	N/A	0.005	mg/l
7440-62-2	Vanadium - SPLP/TCLP	M	1311/1312-6010A	N/A	N/A	0.05	mg/l
7440-66-6	Zinc - SPLP/TCLP	M	1311/1312-6010A	N/A	N/A	5	mg/l
5289290-40-0	Total Petroleum Hydrocarbons	Phy	EPA 418.1	0.5	mg/l	50	mg/kg
SA0001	Alkalinity (to pH 8.3)	WC	EPA 310.1	1	mg/l	5	mg/kg

Table 5-1
PROJECT SPECIFIC PRACTICAL QUANTITATION LIMITS FOR CONSTITUENTS
FOR WHICH ANALYSIS MAY BE CONDUCTED

Page 6 of 6

CAS#	Analyte Name	Type	Project Quantitation Limits			
			Method	Aqueous	Units	Soil
SA0002	Total Alkalinity (to pH 4.5)	WC	EPA 310.1	1	mg/l	5
SA0003	Ammonia	WC	EPA 350.2	1	mg/l	20
SA0004	BOD	WC	EPA 405.1	2	mg/l	200
SA0006	Chloride	WC	EPA 300.0	0.2	mg/l	2
SA0007	COD	WC	EPA 410.2	7	mg/l	1250
SA0008	Cyanide, Total	WC	SW846 9012A	0.005	mg/l	0.1
SA0011	Hexavalent Chromium	WC	SW846 7196A	0.01	mg/l	4
SA0012	Nitrate/Nitrite	WC	EPA 300.0	0.1/0.1	mg/l	1.0/1.0
SA0014	Orthophosphate	WC	EPA 365.3	0.01	mg/l	1
SA0018	Total Dissolved Solids	WC	EPA 160.1	30	mg/l	NA
SA0019	Total Organic Carbon	WC	EPA 415.1/Kahn	1	mg/l	5
SA0023	Total Sulfate	WC	EPA 300.0	0.5	mg/l	5
SA0024	Total Suspended Solids	WC	EPA 160.2	9	mg/l	NA

NOTES:

(1) Fractions: VOA (Volatile Organic, DAI (Direct Aqueous Injection), SV (Semivolatile Organic), OCP (Organochlorine Pesticide), OP (Organophosphorus Pesticide, H (Herbicide), Diox/F (Dioxin/Furan), M (Metal), Phy (Physical), and WC (Wet Chemistry Parameter)

(2) Fictitious CAS number created to represent the coeluting isomers 3-methylphenol and 4-methylphenol.

SW-846 - "Test Methods for Evaluating Solid Waste, Physical Chemical Methods," third edition.

EPA - "Methods for Chemical Analysis of Water and Wastes," EPA 600 4/79-020

The soil PQL was revised for TPH on 6/11/97 from 500 to 50 mg/kg and for chromium on 7/1/97 from 0.5 to 1.0 mg/kg.

The method for SV was revised from 8270A to 8270B on 7/15/97 to reflect the most recent method.

Acetonitrile was added on 7/15/97 to the VOAs with a PQL of 100 ug/l. The soil PQL was also revised for acrylonitrile from 5 ug/kg to 10 ug/kg.

The soil PQL was also revised for acrolein on 7/15/97 from 5 ug/kg to 100 ug/kg.

Table 5-2
ACCURACY AND PRECISION DATA QUALITY OBJECTIVES

Page 1 of 3

Parameter	Audit	Compounds	Aqueous Control Limits	Solid Control Limits
TCL Volatile Compounds	Lab blank, trip blank, or field blank	All TCL Compounds	<5X the QL or methylene chloride, and <QL for all other compounds	<5X the QL or methylene chloride, and <QL for all other compounds
	Matrix Spike Duplicate Precision	All TCL Compounds	Table 5-3	Table 5-3
	Matrix Spike Recovery	All TCL Compounds	Table 5-3	Table 5-3
	Laboratory Control Sample Recovery	All TCL Compounds	Table 5-3	Table 5-3
	Surrogate Spike Recoveries	4-Bromofluorobenzene 1,2-Dichloroethane-d4 Toluene-d8	86-115% 76-114% 88-110%	74-121% 70-121% 81-117%
TCL Semivolatile Compounds	Lab blank, trip blank, or field blank	All TCL Compounds	<QL for all compounds	<QL for all compounds
	Matrix Spike Duplicate Precision	All TCL Compounds	Table 5-3	Table 5-3
	Matrix Spike Recovery	All TCL Compounds	Table 5-3	Table 5-3
	Laboratory Control Sample Recovery	All TCL Compounds	Table 5-3	Table 5-3
	Surrogate Spike Recoveries	Nitrobenzene-d5 2-Fluorobiphenyl p-Terphenyl-d14 Phenol-d6 2-Fluorophenol 2,4,6-Tribromophenol 4,4-Dibromobiphenyl (Spiked onto cartridge before it is sent to the field.)	35-114% 43-116% 33-141% 10-94% 21-100% 10-123% NA	23-120% 30-115% 18-137% 24-113% 25-121% 19-121% NA

Table 5-2
ACCURACY AND PRECISION DATA QUALITY OBJECTIVES

Page 2 of 3

Parameter	Audit	Compounds	Aqueous Control Limits	Solid Control Limits
TCL Pesticides/ PCB Compounds	Lab blank, trip blank, or field blank	All TCL Compounds	<QL for all compounds	<QL for all compounds
	Matrix Spike Duplicate Precision	All TCL Compounds	Table 5-3	Table 5-3
	Matrix Spike Recovery	All TCL Compounds	Table 5-3	Table 5-3
	Laboratory Control Sample Recovery	All TCL Compounds	Table 5-3	Table 5-3
	Surrogate Spike Recoveries	Tetrachloror-meta-xylene decachlorobiphenyl	60-150% 60-150%	60-150% 60-150%
TAL Metals plus Tin	Lab blank, trip blank, or field blank	All TCL Compounds	<PRDL for all compounds	<PRDL for all compounds
	Laboratory Duplicate Precision	All TCL Compounds	Table 5-3	Table 5-3
	Matrix Spike Recovery	All TCL Compounds	Table 5-3	Table 5-3
	Laboratory Control Sample Recovery	All Metals	Table 5-3	Table 5-3
All Wet Chemistry Parameters	Lab blank, trip blank, or field blank	All Parameters	<QL for all compounds	<QL for all compounds
	Laboratory Duplicate Precision	All Parameters	Table 5-3	Table 5-3
	Matrix Spike Recovery	All Parameters	Table 5-3	Table 5-3
	Laboratory Control Sample Recovery	All Parameters	Table 5-3	Table 5-3

Table 5-2
ACCURACY AND PRECISION DATA QUALITY OBJECTIVES

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Parameter	Audit	Compounds	Aqueous Control Limits	Solid Control Limits
Dioxins/ Dibenzofurans	Lab blank, trip blank, or field blank	All Compounds	<5X the QL or methylene chloride, and <QL for all other compounds	<5X the QL or methylene chloride, and <QL for all other compounds
	Matrix Spike Duplicate Precision	All Compounds	Table 5-3	Table 5-3
	Matrix Spike Recovery	All Compounds	Table 5-3	Table 5-3
	Laboratory Control Sample Recovery	All Compounds	Table 5-3	Table 5-3
	Recovery Standard Recovery	C13-1,2,3,4-TCDD	>40%	>40%

Notes: QL = Quantitation limit; PRDL = Project required detection Limit; TCL = TargetCompound List; NA= Not Applicable

Table 5-3
MATRIX SPIKE AND LABORATORY CONTROL SAMPLE
PRECISION AND ACCURACY OBJECTIVES

Page 1 of 8

CAS#	Analyte Name	Aqueous			Solid/Soil		
		MS/MSD % Recovery	MS/MSD or LD % RPD	LCS% Recovery	MS/MSD % Recovery	MS/MSD or LD % RPD	LCS% Recovery
67-64-1	Acetone	36-132	15	36-132	33-138	40	33-138
71-43-2	Benzene	50-150	15	50-150	42-167	40	42-167
75-27-4	Bromodichloromethane	19-146	15	19-146	45-453	40	45-453
75-25-2	Bromoform	29-141	15	29-141	42-153	40	42-153
74-83-9	Methyl bromide	13-174	15	13-174	34-164	40	34-164
78-93-3	Methyl ethyl ketone	35-153	15	35-153	46-146	40	46-146
75-15-0	Carbon disulfide	14-171	15	14-171	39-153	40	39-153
56-23-5	Carbon tetrachloride	52-151	15	52-151	42-168	40	42-168
108-90-7	Chlorobenzene	54-149	15	54-149	43-164	40	43-164
75-00-3	Chloroethane	16-167	15	16-167	31-160	40	31-160
67-66-3	Chloroform	56-152	15	56-152	46-160	40	46-160
74-87-3	Methyl chloride	30-170	15	30-170	25-175	40	25-175
124-48-1	Chlorodibromomethane	33-150	15	33-150	44-151	40	44-151
75-34-3	1,1-Dichloroethene	36-166	15	36-166	44-164	40	44-164
107-06-2	1,2-Dichloroethene	52-149	15	52-149	46-160	40	46-160
75-35-4	1,1-Dichloroethane	22-181	15	22-181	52-166	40	52-166
540-59-0	1,2-Dichloroethane (total)	53-149	15	53-149	43-167	40	43-167
78-87-5	1,2-Dichloropropane	36-164	15	36-164	46-163	40	46-163
10061-01-5	cis-1,3-Dichloropropene	47-140	15	47-140	45-153	40	45-153
10061-02-6	trans-1,3-dichloropropene	27-143	15	27-143	35-19	40	35-19
100-41-4	Ethylbenzene	54-157	15	54-157	45-172	40	45-172
591-78-6	Methyl butyl ketone	34-141	15	34-141	55-134	40	55-134
75-09-2	Methylene chloride	52-156	15	52-156	41-181	40	41-181
108-10-1	Methyl isobutyl ketone	45-119	15	45-119	54-128	40	54-128
100-42-5	Styrene	44-153	15	44-153	76-132	40	76-132
79-34-5	1,1,2,2-Tetrachloroethane	40-139	15	40-139	43-148	40	43-148
127-18-4	Tetrachloroethene	51-165	15	51-165	43-183	40	43-183
108-88-3	Toluene	49-156	15	49-156	44-170	40	44-170
71-55-6	1,1,1-Trichloroethane	1-144	15	1-144	45-166	40	45-166
79-00-5	1,1,2-Trichloroethane	48-142	15	48-142	44-156	40	44-156
79-01-6	Trichloroethene	36-159	15	36-159	42-169	40	42-169
75-01-4	Vinyl chloride	38-168	15	38-168	31-176	40	31-176
1330-20-7	Xylenes (total)	52-150	15	52-150	42-162	40	42-162

Table 5-3
MATRIX SPIKE AND LABORATORY CONTROL SAMPLE
PRECISION AND ACCURACY OBJECTIVES

Page 2 of 8

CAS#	Analyte Name	Aqueous			Solid/Soil		
		MS/MSD % Recovery	MS/MSD or LD % RPD	LCS% Recovery	MS/MSD % Recovery	MS/MSD or LD % RPD	LCS% Recovery
95-50-1	1,2-Dichlorobenzene	NA	NA	NA	NA	NA	NA
541-73-1	1,3-Dichlorobenzene	NA	NA	NA	NA	NA	NA
106-46-7	1,4-Dichlorobenzene	NA	NA	NA	NA	NA	NA
87-68-3	Hexachlorobutadiene	NA	NA	NA	NA	NA	NA
67-64-1	Acetone	NA	NA	NA	70-130	40	70-130
71-43-2	Benzene	NA	NA	NA	87-122	40	87-122
75-27-4	Bromodichloromethane	NA	NA	NA	82-121	40	82-121
75-25-2	Bromoform	NA	NA	NA	80-144	40	80-144
74-83-9	Methyl bromide	NA	NA	NA	69-117	40	69-117
78-93-3	Methyl ethyl ketone	NA	NA	NA	70-130	40	70-130
56-23-5	Carbon tetrachloride	NA	NA	NA	88-121	40	88-121
108-90-7	Chlorobenzene	NA	NA	NA	36-140	40	36-140
75-00-3	Chloroethane	NA	NA	NA	68-114	40	68-114
67-66-3	Chloroform	NA	NA	NA	81-120	40	81-120
74-87-3	Methyl chloride	NA	NA	NA	52-112	40	52-112
124-48-1	Chlorodibromomethane	NA	NA	NA	80-128	40	80-128
75-34-3	1,1-Dichloroethene	NA	NA	NA	75-125	40	75-125
107-06-2	1,2-Dichloroethene	NA	NA	NA	80-117	40	80-117
75-35-4	1,1-Dichloroethane	NA	NA	NA	83-128	40	83-128
540-59-0	1,2-Dichloroethane (total)	NA	NA	NA	81-122	40	81-122
78-87-5	1,2-Dichloropropane	NA	NA	NA	87-118	40	87-118
10061-01-5	cis-1,3-Dichloropropene	NA	NA	NA	82-119	40	82-119
10061-02-6	trans-1,3-Dichloropropene	NA	NA	NA	82-120	40	82-120
100-41-4	Ethylbenzene	NA	NA	NA	90-122	40	90-122
75-09-2	Methylene chloride	NA	NA	NA	76-118	40	76-118
100-42-5	Styrene	NA	NA	NA	90-110	40	90-110
79-34-5	1,1,2,2-tetrachloroethane	NA	NA	NA	75-125	40	75-125
127-18-4	Tetrachloroethene	NA	NA	NA	87-122	40	87-122
108-88-3	Toluene	NA	NA	NA	93-117	40	93-117
71-55-6	1,1,1-Trichloroethane	NA	NA	NA	86-122	40	86-122
79-00-5	1,1,2-Trichloroethane	NA	NA	NA	76-114	40	76-114

Table 5-3
MATRIX SPIKE AND LABORATORY CONTROL SAMPLE
PRECISION AND ACCURACY OBJECTIVES

Page 3 of 8

CAS#	Analyte Name	Aqueous			Solid/Soil		
		MS/MSD % Recovery	MS/MSD or LD % RPD	LCS% Recovery	MS/MSD % Recovery	MS/MSD or LD % RPD	LCS% Recovery
79-01-6	Trichloroethene	NA	NA	NA	85-121	40	85-121
75-01-4	Vinyl chloride	NA	NA	NA	61-168	40	61-168
1330-20-7	Xylenes (total)	NA	NA	NA	90-119	40	90-119
83-32-9	Acenaphthene	58.39-107.83	20	58.39-107.83	45.73-117.01	40	45.73-117.01
208-96-8	Acenaphthylene	50.14-111.64	20	50.14-111.64	42.67-116.41	40	42.67-116.41
120-12-7	Anthracene	59.13-104.31	20	59.13-104.31	41.19-120.63	40	41.19-120.63
56-55-3	Benzo[a]anthracene	60.62-111.02	20	60.62-111.02	47.96-123.56	40	47.96-123.56
205-99-2	Benzo[b]fluoranthene	55.22-114.20	20	55.22-114.20	39.96-133.92	40	39.96-133.92
207-08-9	Benzo[k]fluoranthene	49.90-125.86	20	49.90-125.86	41.33-134.27	40	41.33-134.27
191-24-2	Benzo[ghi]perylene	47.16-137.46	20	47.16-137.46	35.21-146.69	40	35.21-146.69
50-32-8	Benzo[a]pyrene	47.80-122.74	20	47.80-122.74	42.29-137.51	40	42.29-137.51
111-91-1	bis(2-Chloroethoxy)methane	47.27-109.25	20	47.27-109.25	40.76-116.66	40	40.76-116.66
111-44-4	bis(2-Chloroethyl)ether	53-102.32	20	53-102.32	39.39-116.18	40	39.39-116.18
108-60-1	bis(2-Chloroisopropyl)ether	42.17-117.29	20	42.17-117.29	65.39-108.29	40	65.39-108.29
117-81-7	bis(2-Ethylhexyl)phthalate	54.78-121.56	20	54.78-121.56	45.00-131.76	40	45.00-131.76
101-55-3	4-Bromophenyl phenyl ether	60.34-105.70	20	60.34-105.70	45.59-122.81	40	45.59-122.81
85-68-7	Butyl benzyl phthalate	49.45-118.99	20	49.45-118.99	47.86-134.62	40	47.86-134.62
106-47-8	4-Chloroaniline	49.33-99.43	20	49.33-99.43	D.L.-123.34	40	D.L.-123.34
59-50-7	4-Chloro-3-methylphenol	57.92-111.02	20	57.92-111.02	48.26-117.20	40	48.26-117.20
91-58-7	2-Chloronaphthalene	54.92-105.08	20	54.92-105.08	45.47-117.23	40	45.47-117.23
95-57-8	2-Chlorophenol	55.79-100.73	20	55.79-100.73	42.49-114.43	40	42.49-114.43
7005-72-3	4-Chlorophenyl phenyl ether	54.35-107.75	20	54.35-107.75	48.77-116.81	40	48.77-116.81
218-01-9	Chrysene	58.36-114.52	20	58.36-114.52	47.92-126.04	40	47.92-126.04
132-64-9	Dibenzofuran	54.76-113.08	20	54.76-113.08	67.35-102.93	40	67.35-102.93
84-74-2	Di-n-butyl phthalate	54.11-114.77	20	54.11-114.77	42.68-125.66	40	42.68-125.66
53-70-3	Dibenz[a,h]anthracene	49.70-145.52	20	49.70-145.52	44.99-154.13	40	44.99-154.13
95-50-1	1,2-Dichlorobenzene	47.02-97.78	20	47.02-97.78	38.75-112.33	40	38.75-112.33
541-73-1	1,3-Dichlorobenzene	42.68-94.40	20	42.68-94.40	37.33-112.33	40	37.33-112.33
106-46-7	1,4-Dichlorobenzene	42.63-94.40	20	42.63-94.40	38.76-110.40	40	38.76-110.40
91-94-1	3,3-Dichlorobenzidine	51.64-112.24	20	51.64-112.24	18.95-116.93	40	18.95-116.93
120-83-2	2,4-Dichlorophenol	55.97-105.05	20	55.97-105.05	45.61-116.89	40	45.61-116.89

Table 5-3
MATRIX SPIKE AND LABORATORY CONTROL SAMPLE
PRECISION AND ACCURACY OBJECTIVES

Page 4 of 8

CAS#	Analyte Name	Aqueous			Solid/Soil		
		MS/MSD % Recovery	MS/MSD or LD % RPD	LCS% Recovery	MS/MSD % Recovery	MS/MSD or LD % RPD	LCS% Recovery
84-66-2	Diethyl phthalate	47.59-114.55	20	47.59-114.55	49.02-126.90	40	49.02-126.90
105-67-9	2,4-Dimethylphenol	51.83-94.37	20	51.83-94.37	32.55-112.71	40	32.55-112.71
131-11-3	Dimethyl phthalate	25.46-106.28	20	25.46-106.28	48.92-123.26	40	48.92-123.26
534-52-1	4,6-Dinitro-2-methylphenol	52.71-117.15	20	52.71-117.15	27.89-147.11	40	27.89-147.11
51-28-5	2,4-Dinitrophenol	42.60-130.86	20	42.60-130.86	9.14-166.64	40	9.14-166.64
121-14-2	2,4-Dinitrotoluene	55.68-117.66	20	55.68-117.66	48.40-126.46	40	48.40-126.46
606-20-2	2,6-Dinitrotoluene	55.84-106.48	20	55.84-106.48	46.52-121.70	40	46.52-121.70
117-84-0	Di-n-octyl phthalate	44.18-139.70	20	44.18-139.70	34.97-149.65	40	34.97-149.65
206-44-0	Fluoranthene	53.22-114.72	20	53.22-114.72	44.46-121.20	40	44.46-121.20
86-73-7	Fluorene	50.51-113.15	20	50.51-113.15	46.12-114.46	40	46.12-114.46
118-74-1	Hexachlorobenzene	62.54-107.66	20	62.54-107.66	44.07-126.09	40	44.07-126.09
87-68-3	Hexachlorobutadiene	29.68-84.88	20	29.68-84.88	41.27-117.23	40	41.27-117.23
77-47-4	Hexachlorocyclopentadiene	D.L.-131.66	20	D.L.-131.66	D.L.-124.98	40	D.L.-124.98
67-72-1	Hexachloroethane	34.65-82.53	20	34.65-82.53	38.86-110.44	40	38.86-110.44
193-39-5	Indeno(1,2,3-cd)pyrene	48.29-141.29	20	48.29-141.29	44.43-150.75	40	44.43-150.75
78-59-1	Isophorone	54.27-105.57	20	54.27-105.57	40.63-114.85	40	40.63-114.85
91-57-6	2-Methylnaphthalene	48.84-103.80	20	48.84-103.80	61.07-98.99	40	61.07-98.99
95-48-7	2-Methylphenol	46.89-87.27	20	46.89-87.27	58.39-114.37	40	58.39-114.37
91-20-3	Naphthalene	49.92-108.42	20	49.92-108.42	41.40-115.26	40	41.40-115.26
88-74-4	2-Nitroaniline	58.80-112.02	20	58.80-112.02	74.00-102.38	40	74.00-102.38
99-09-2	3-Nitroaniline	50.46-113.88	20	50.46-113.88	47.25-105.03	40	47.25-105.03
100-01-6	4-Nitroaniline	53.97-125.73	20	53.97-125.73	36.90-107.64	40	36.90-107.64
98-95-3	Nitrobenzene	54.14-106.10	20	54.14-106.10	42.61-116.17	40	42.61-116.17
88-75-5	2-Nitrophenol	65.48-111.74	20	65.48-111.74	43.95-122.19	40	43.95-122.19
100-02-7	4-Nitrophenol	16.88-67.70	20	16.88-67.70	42.30-145.62	40	42.30-145.62
86-30-6	N-Nitrosodiphenylamine	32.68-69.58	20	32.68-69.58	39.02-124.78	40	39.02-124.78
621-64-7	N-Nitrosodipropylamine	50.73-112.47	20	50.73-112.47	40.40-119.78	40	40.40-119.78
87-86-5	Pentachlorophenol	29.27-134.93	20	29.27-134.93	18.06-160.62	40	18.06-160.62
85-01-8	Phenanthrene	59.89-108.49	20	59.89-108.49	43.36-121.12	40	43.36-121.12
108-95-2	Phenol	28.09-58.09	20	28.09-58.09	36.01-121.09	40	36.01-121.09
129-00-0	Pyrene	58.27-118.03	20	58.27-118.03	44.59-130.03	40	44.59-130.03
120-82-1	1,2,4-Trichlorobenzene	44.87-100.25	20	44.87-100.25	41.81-114.23	40	41.81-114.23

Table 5-3
MATRIX SPIKE AND LABORATORY CONTROL SAMPLE
PRECISION AND ACCURACY OBJECTIVES

Page 5 of 8

CAS#	Analyte Name	Aqueous			Solid/Soil		
		MS/MSD % Recovery	MS/MSD or LD % RPD	LCS% Recovery	MS/MSD % Recovery	MS/MSD or LD % RPD	LCS% Recovery
95-95-4	2,4,5-Trichlorophenol	61.65-118.29	20	61.65-118.29	68.75-114.59	40	68.75-114.59
88-06-2	2,4,6-Trichlorophenol	50.28-108.54	20	50.28-108.54	45.83-118.31	40	45.83-118.31
86-74-8	Carbazole	39.6-136.8	20	39.6-136.8	35.3-133.1	40	35.3-133.1
309-00-2	Aldrin	59-120	20	59-120	62-120	40	62-120
319-84-6	alpha-BHC	69-120	20	69-120	59-120	40	59-120
319-85-7	beta-BHC	72-115	20	72-115	72-115	40	72-115
319-86-8	delta-BHC	62-120	20	62-120	68-110	40	68-110
58-89-9	gamma-BHC/Lindane	79-120	20	79-120	63-120	40	63-120
72-54-8	4,4-DDD	71-115	20	71-115	65-120	40	65-120
72-55-9	4,4-DDE	69-105	20	69-105	63-120	40	63-120
50-29-3	4,4-DDT	74-120	20	74-120	59-121	40	59-121
60-57-1	Dieldrin	77-120	20	77-120	55-123	40	55-123
959-98-8	Endosulfan I	72-110	20	72-110	57-120	40	57-120
33213-65-9	Endosulfan II	76-120	20	76-120	64-120	40	64-120
1031-07-8	Endosulfan sulfate	63-120	20	63-120	62-120	40	62-120
72-20-8	Endrin	73-120	20	73-120	64-124	40	64-124
7421-93-4	Endrin aldehyde	70-121	20	70-121	31-120	40	31-120
76-44-8	Heptachlor	64-120	20	64-120	45-120	40	45-120
1024-57-3	Heptachlor epoxide	80-120	20	80-120	71-126	40	71-126
72-43-5	Methoxychlor	76-120	20	76-120	39-129	40	39-129
8001-35-2	Toxaphene	NA	NA	NA	NA	NA	NA
12674-11-2	Aroclor-1016	NA	NA	NA	NA	NA	NA
11104-28-2	Aroclor-1221	NA	NA	NA	NA	NA	NA
11141-16-5	Aroclor-1232	NA	NA	NA	NA	NA	NA
53469-21-9	Aroclor-1242	75-120	20	75-120	69-115	40	69-115
12672-29-6	Aroclor-1248	NA	NA	NA	NA	NA	NA
11097-69-1	Aroclor-1254	NA	NA	NA	NA	NA	NA
11096-82-5	Aroclor-1260	77-120	20	77-120	71-119	40	71-119
5103-71-9	alpha-Chlordane	60-140	20	60-140	60-140	40	60-140
5103-74-2	gamma-Chlordane	60-140	20	60-140	60-140	40	60-140
53494-70-5	Endrin ketone	60-140	20	60-140	60-140	40	60-140

Table 5-3
MATRIX SPIKE AND LABORATORY CONTROL SAMPLE
PRECISION AND ACCURACY OBJECTIVES

Page 6 of 8

CAS#	Analyte Name	Aqueous			Solid/Soil		
		MS/MSD % Recovery	MS/MSD or LD % RPD	LCS% Recovery	MS/MSD % Recovery	MS/MSD or LD % RPD	LCS% Recovery
1-33-1	Total-TCDD	NA	NA	NA	NA	NA	NA
1746-01-6	2378-TCDD	60-140	50	57-128	60-140	50	55-136
1-33-2	Total-TCDF	NA	NA	NA	NA	NA	NA
51207-31-9	2378-TCDF	60-140	50	62-129	60-140	50	72-118
1-28-9	Total PeCDD	NA	NA	NA	NA	NA	NA
40321-76-4	12378-PeCDD	60-140	50	80-125	60-140	50	67-139
1-29-0	Total PeCDF	NA	NA	NA	NA	NA	NA
57117-41-6	123478-PeCDF	NA	NA	NA	NA	NA	NA
57117-31-4	123678-PeCDF	60-140	50	51-132	60-140	50	54-129
1-20-0	Total HeCDD	NA	NA	NA	NA	NA	NA
39227-28-6	123478-HeCDD	60-140	50	64-27	60-140	50	57-132
57653-85-7	123678-HeCDD	NA	NA	NA	NA	NA	NA
19408-74-3	123789-HeCDD	NA	NA	NA	NA	NA	NA
1-20-1	Total HeCDF	NA	NA	NA	NA	NA	NA
70648-26-9	123478-HeCDF	60-140	50	50-146	60-140	50	50-150
57117-44-9	123678-HeCDF	NA	NA	NA	NA	NA	NA
72918-21-9	123789-HeCDF	NA	NA	NA	NA	NA	NA
60851-34-5	234678-HeCDF	NA	NA	NA	NA	NA	NA
1-01-9	Total HpCDD	NA	NA	NA	NA	NA	NA
35822-46-9	1234678-HpCDD	60-140	50	60-131	60-140	50	50-138
1-02-0	Total HpCDF	NA	NA	NA	NA	NA	NA
67562-39-4	1234678-HpCDF	60-140	50	50-150	60-140	50	50-150
55673-89-7	11234789-HpCDF	NA	NA	NA	NA	NA	NA
3268-87-9	OCDD	60-140	50	50-147	60-140	50	50-149
39001-1-2	OCDF	60-140	50	50-150	60-140	50	50-150
7440-36-0	Antimony	75-125	20	75-125	75-125	20	75-125
7440-38-2	Arsenic	75-125	20	75-125	75-125	20	75-125
7440-39-3	Barium	75-125	20	75-125	75-125	20	75-125
7440-41-7	Beryllium	75-125	20	75-125	75-125	20	75-125
7440-43-9	Cadmium	75-125	20	75-125	75-125	20	75-125

Table 5-3
MATRIX SPIKE AND LABORATORY CONTROL SAMPLE
PRECISION AND ACCURACY OBJECTIVES

Page 7 of 8

CAS#	Analyte Name	Aqueous			Solid/Soil		
		MS/MSD % Recovery	MS/MSD or LD % RPD	LCS% Recovery	MS/MSD % Recovery	MS/MSD or LD % RPD	LCS% Recovery
7440-47-3	Chromium	75-125	20	75-125	75-125	20	75-125
7440-48-4	Cobalt	75-125	20	75-125	75-125	20	75-125
7440-50-8	Copper	75-125	20	75-125	75-125	20	75-125
7439-92-1	Lead	75-125	20	75-125	75-125	20	75-125
7439-97-6	Mercury	75-125	20	75-125	75-125	20	75-125
7440-02-0	Nickel	75-125	20	75-125	75-125	20	75-125
7782-49-2	Selenium	75-125	20	75-125	75-125	20	75-125
7440-22-4	Silver	75-125	20	75-125	75-125	20	75-125
7440-28-0	Thallium	75-125	20	75-125	75-125	20	75-125
7440-31-5	Tin	75-125	20	75-125	75-125	20	75-125
7440-62-2	Vanadium	75-125	20	75-125	75-125	20	75-125
7440-66-6	Zinc	75-125	20	75-125	75-125	20	75-125
7429-90-5	Aluminum	75-125	20	75-125	75-125	20	75-125
7440-70-2	Calcium	75-125	20	75-125	75-125	20	75-125
7439-89-6	Iron	75-125	20	75-125	75-125	20	75-125
7439-95-4	Magnesium	75-125	20	75-125	75-125	20	75-125
7439-96-5	Manganese	75-125	20	75-125	75-125	20	75-125
7440-09-7	Potassium	75-125	20	75-125	75-125	20	75-125
7440-23-5	Sodium	75-125	20	75-125	75-125	20	75-125
SA0001	Alkalinity (to pH 8.3)	75-125	20	75-125	75-125	20	75-130
SA0002	Total Alkalinity (to pH 4.5)	75-125	20	75-125	75-125	20	75-130
SA0003	Ammonia	75-125	20	75-125	75-125	20	75-130
SA0004	BOD	75-125	20	75-125	75-125	20	75-130
SA0006	Chloride	75-125	20	75-125	75-125	20	75-130
SA0007	COD	75-125	20	75-125	75-125	20	75-130
SA0008	Cyanide, Total	75-125	20	75-125	75-125	20	75-130
SA0011	Hexavalent Chromium	75-125	20	75-125	75-125	20	75-130
SA0012	Nitrate/Nitrite	75-125	20	75-125	75-125	20	75-130
SA0014	Orthophosphate	75-125	20	75-125	75-125	20	75-130
SA0018	Total Dissolved Solids	75-125	20	75-125	75-125	20	75-130
SA0019	Total Organic Carbon	75-125	20	75-125	75-125	20	75-130

Table 5-3
MATRIX SPIKE AND LABORATORY CONTROL SAMPLE
PRECISION AND ACCURACY OBJECTIVES

Page 8 of 8

CAS#	Analyte Name	Aqueous			Solid/Soil		
		MS/MSD % Recovery	MS/MSD or LD % RPD	LCS% Recovery	MS/MSD % Recovery	MS/MSD or LD % RPD	LCS% Recovery
SA0023	Total Sulfate	75-125	20	75-125	75-125	20	75-130
SA0024	Total Suspended Solids	75-125	20	75-125	75-125	20	75-130

NOTES:

(1) Fractions: VOA - Volatile Organic Analytes; DAI - Direct Aqueous Injection; SV - Semivolatile Organics; OCP - Organochlorine Pesticides

OP - Organophosphorus Pesticides; H - Herbicides; DIOX/F - Dioxins/Furans; M - Metals; WC - Wet Chemistry; RAD - Radiological

(2) Fictitious CAS numbers created to represent the co-eluting isomers 3-methylphenol and 4-methylphenol.

TBD - PQL to be determined

SW-846 - "Test Methods for Evaluating Solid Waste, Physical Chemical Methods," third edition.

EPA - "Methods for Chemical Analysis of Water and Wastes," EPA 600-4/79-020.

Table 5-4

**Willow Brook and Willow Brook Pond
East Hartford, Connecticut**

**Quality Assurance Project Plan
Field Calibration Frequency**

Equipment	Calibration Check	Calibration Standards	Initial Calibration Frequency
pH Meter	Prior to use-daily	pH 4.0 pH 7.0 pH 10.0	1 Month
Conductivity Meter	Prior to use-daily	1,000 mg/l NaCl	N/A
Water Level Meter	Prior to use-daily	100' engineers' tape	N/A
Turbidity Meter	Prior to use-daily	0.5 NTU	N/A

Notes:

1. N/A = not applicable.
2. NTU= nephelometric turbidity units.
3. mg/l = milligrams per liter.
4. ppm = parts per million.

Table 5-5

**Willow Brook and Willow Brook Pond
East Hartford, Connecticut**

**Quality Assurance Project Plan
Field Measurements Quality Control**

Field Parameter	Precision¹	Accuracy
Water Temperature	$\pm 1^{\circ} \text{C}$	$\pm 1^{\circ} \text{C}$ Instrument Capability
pH	$\pm 1 \text{ pH S.U.}$	$\pm 1 \text{ pH S.U.}$ (Instrument Capability)
Conductivity	$\pm 1 \text{ mS/cm}$	$\pm 5 \%$ Standard
Dissolved Oxygen	$\pm 0.02 \text{ mg/L}$	$\pm 5 \%$
Turbidity	$\pm 1.0 \text{ NTU}$	$\pm 2 \%$ Standard
Water Level	$\pm 0.01 \text{ foot}$	$\pm 0.01 \text{ foot}$

Notes:

1. ¹ = Precision units presented in applicable significant figures.
2. S.U. = standard units
3. mS/cm = millisiemens per centimeter
4. mg/L = milligrams per liter

Table 5-6
REQUIRED CONTAINERS, PRESERVATIVES, AND ANALYSIS HOLDING TIMES
FOR SOLID, AQUEOUS AND VAPOR SAMPLES

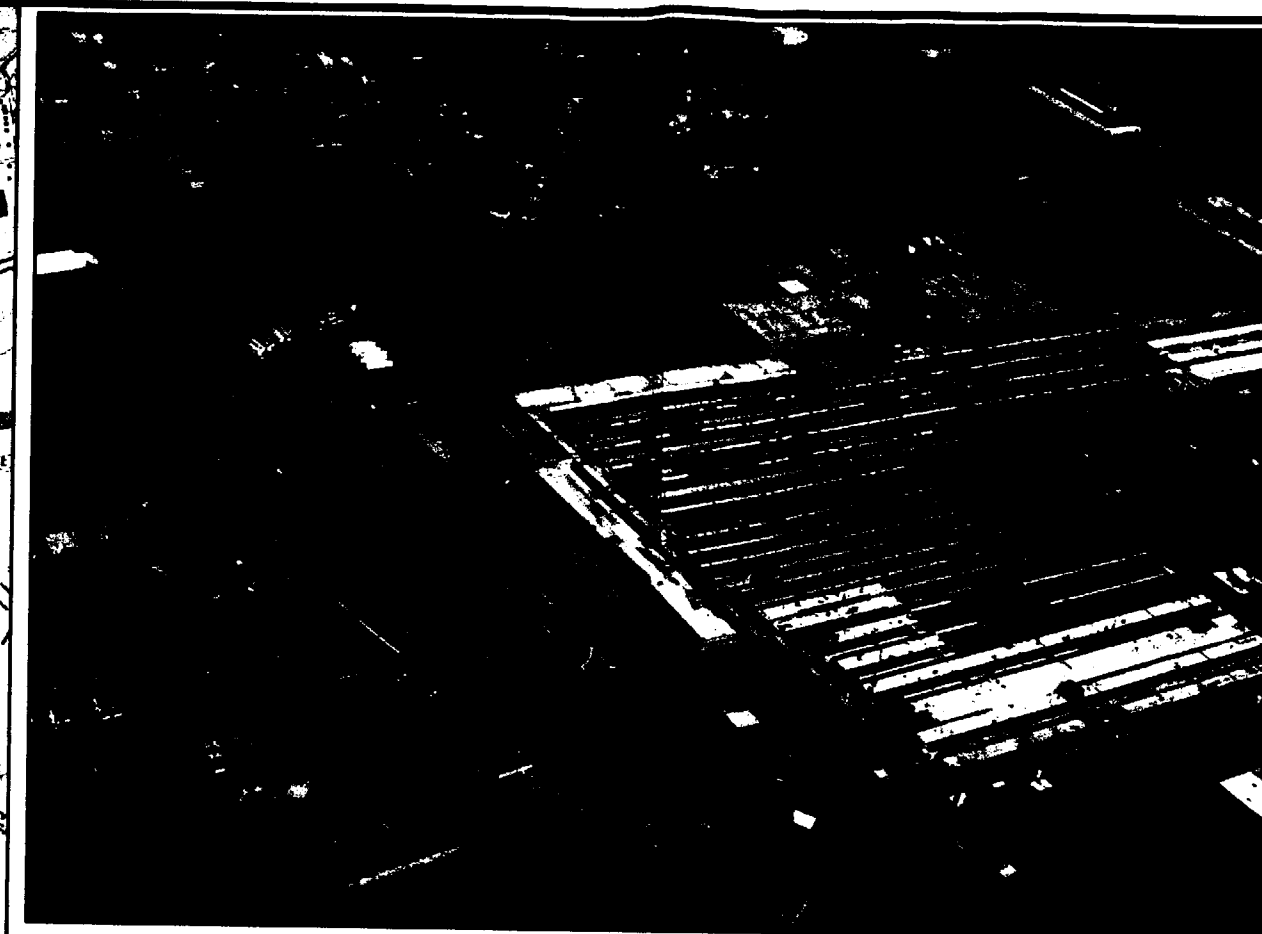
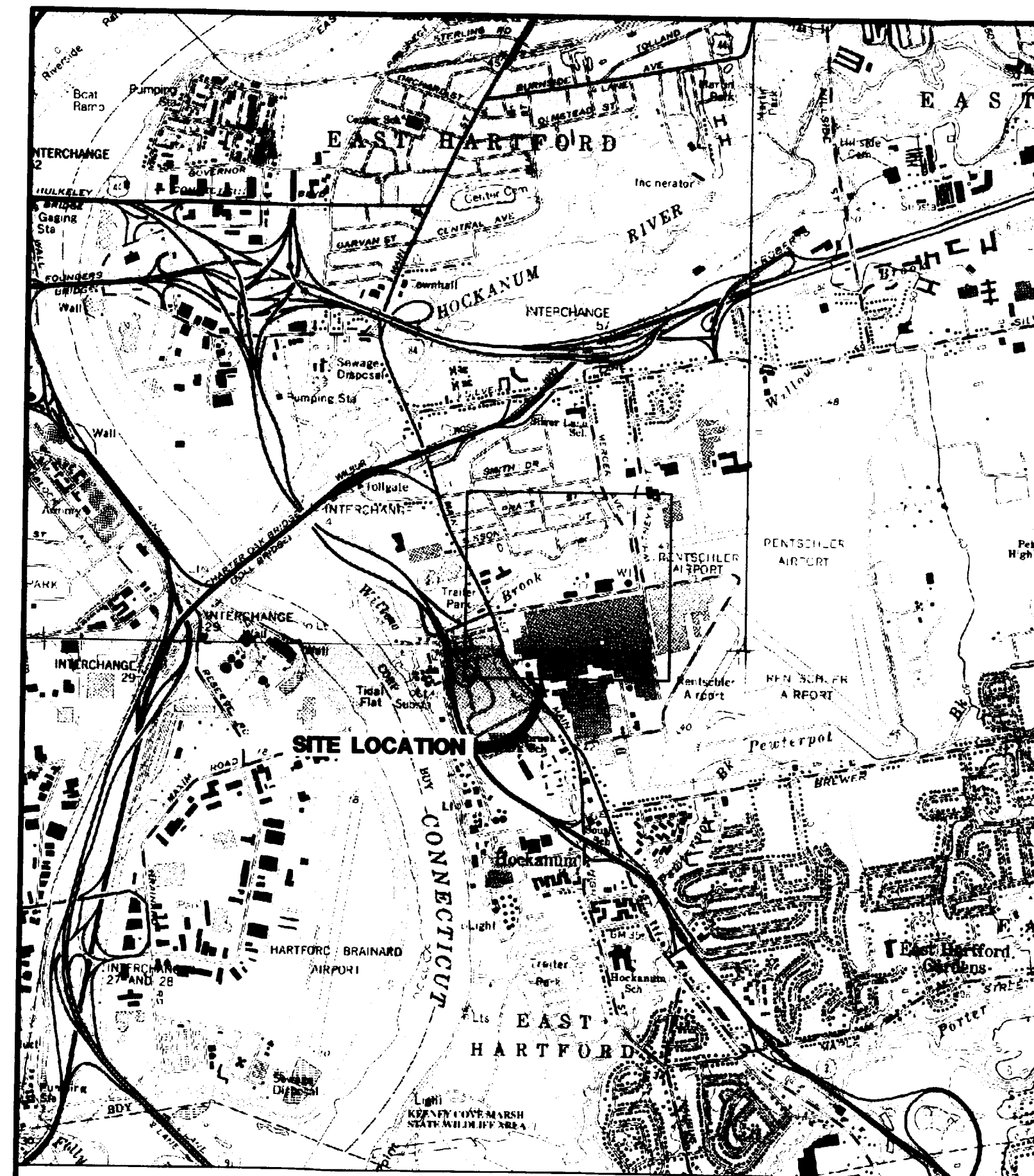
Page 1 of 1

Fraction	Soil/Solid Sample Bottle	Preservative	Holding Time
TCL Volatiles	1-4 oz. glass w/Teflon lined enclosure	Cool to 4 C	14 days
TCL Semivolatiles	1-16 oz. glass w/Teflon lined enclosure	Cool to 4 C	14 days till extraction/40 days to inject extract
TCL Organochlorine Pesticides/PCBs	from same 16 oz. above	Cool to 4 C	14 days till extraction/40 days to inject extract
chloride, sulfate, ammonia, COD	from same 16 oz. above	Cool to 4 C	28 days
alkalinity	from same 16 oz. above	Cool to 4 C	14 days
nitrate, nitrite, o-phosphate, BOD	from same 16 oz. above	Cool to 4 C	48 hours
hexavalent chromium	from same 16 oz. above	Cool to 4 C	48 hours
TAL metals plus Tin	from same 16 oz. above	Cool to 4 C	28 days Hg & 180 days all other metals
Cyanides	from same 4 oz. above	Cool to 4 C	14 days
Dioxins	1-4 oz. glass w/Teflon lined enclosure.	Cool to 4 C	30 days till extraction/45 days to complete analysis
TOC	from same 16 oz. above	Cool to 4 C	28 days
Trip Blank, Field Blank or Aqueous Sample			
TCL Volatiles	2-40 ml glass screw cap vials with Teflon septa	HCl to pH <2, Cool to 4 C	14 days
TCL Semivolatiles	2-1 liter amber glass with Teflon lined cap	Cool to 4 C	7 days extraction/40 days to inject
TCL Organochlorine Pesticides/PCBs	2-1 liter amber glass with Teflon lined cap	Cool to 4 C	7 days extraction/40 days to inject
TAL Metals plus Tin	1-1 liter HDP	HNO to pH<2	28 days Hg & 180 days all other metals
Cyanides	1-1 liter HDP	NaOH to pH>12, Cool to 4 C	14 days
Dioxins	2-1 liter amber glass with Teflon lined cap	Cool to 4 C	30 days extraction/45 days to complete analysis
Chloride, sulfate	1-1 liter HDP	Cool to 4 C	28 days
TDS, TSS			7 days
alkalinity			14 days
nitrate, nitrite, o-phosphate, BOD	1-1 liter HDP	Cool to 4 C	48 hours
hexavalent chromium	1-500 ml HDP	Cool to 4 C	24 hours
ammonia, COD	1-1 liter clear glass with Teflon lined cap	HSO to pH<2, Cool to 4 C	28 days
TOC	1-125 ml glass with Teflon lined cap	HSO to pH<2, Cool to 4 C	28 days
Fraction	Air Sample Container/Media	Preservative	Holding Time
TCL Volatiles	SUMMA Canister	None	14 days
TCL Semivolatiles	XAD-2/PUF Cartridges	Cool to 4 C	14 days extraction/40 days to inject
TAL Metals plus Tin	Quartz Filter	None	28 days Hg & 180 days all other metals
Total Suspended Particulate Matter	Quartz Filter	None	14 days

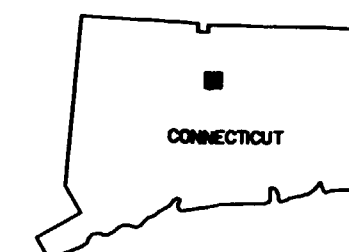
NOTES

- 1 - Depending on how sample analyses are distributed between the laboratories, additional sample bottles may be required.
- 2 - Holding times are from the date of sample collection.

FIGURES



NOTE: AERIAL PHOTO TAKEN ON DECEMBER 30, 1988.



Originals in color.

REMEDIAL ACTION WORK PLAN
UTC/P & W, Willow Brook & Willow Brook Pond

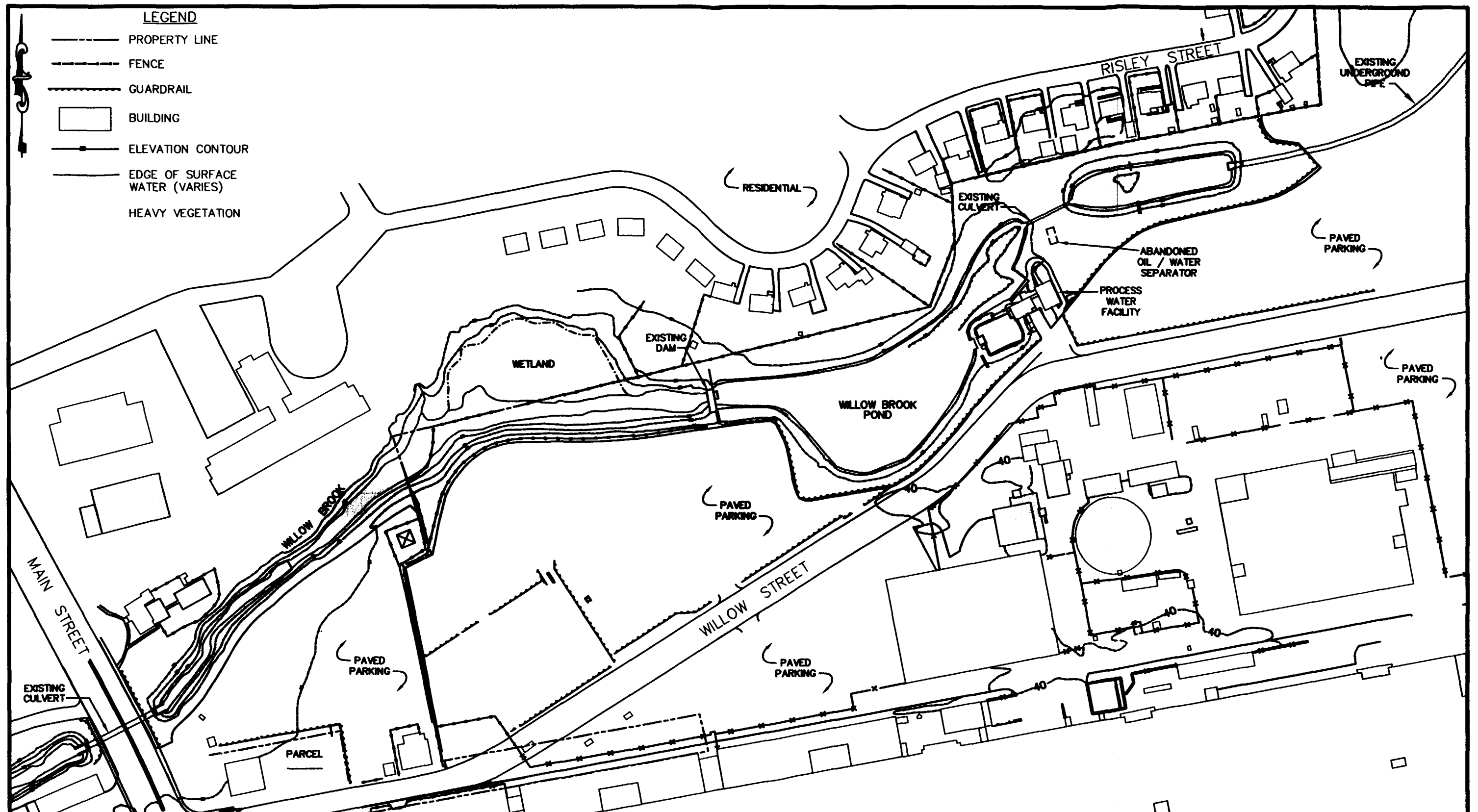
SITE LOCATION MAP

Comm.No.

88UT002.001

FIGURE 1-1





NOTES

1. BASE MAP FROM ELECTRONIC FILE OF LOUREIRO ENGINEERING ASSOCIATES, P.C. DRAWING, DATED 12/1/96 AND FROM USGS AERIAL PHOTOGRAPHY, 1994.

Original includes color coding.

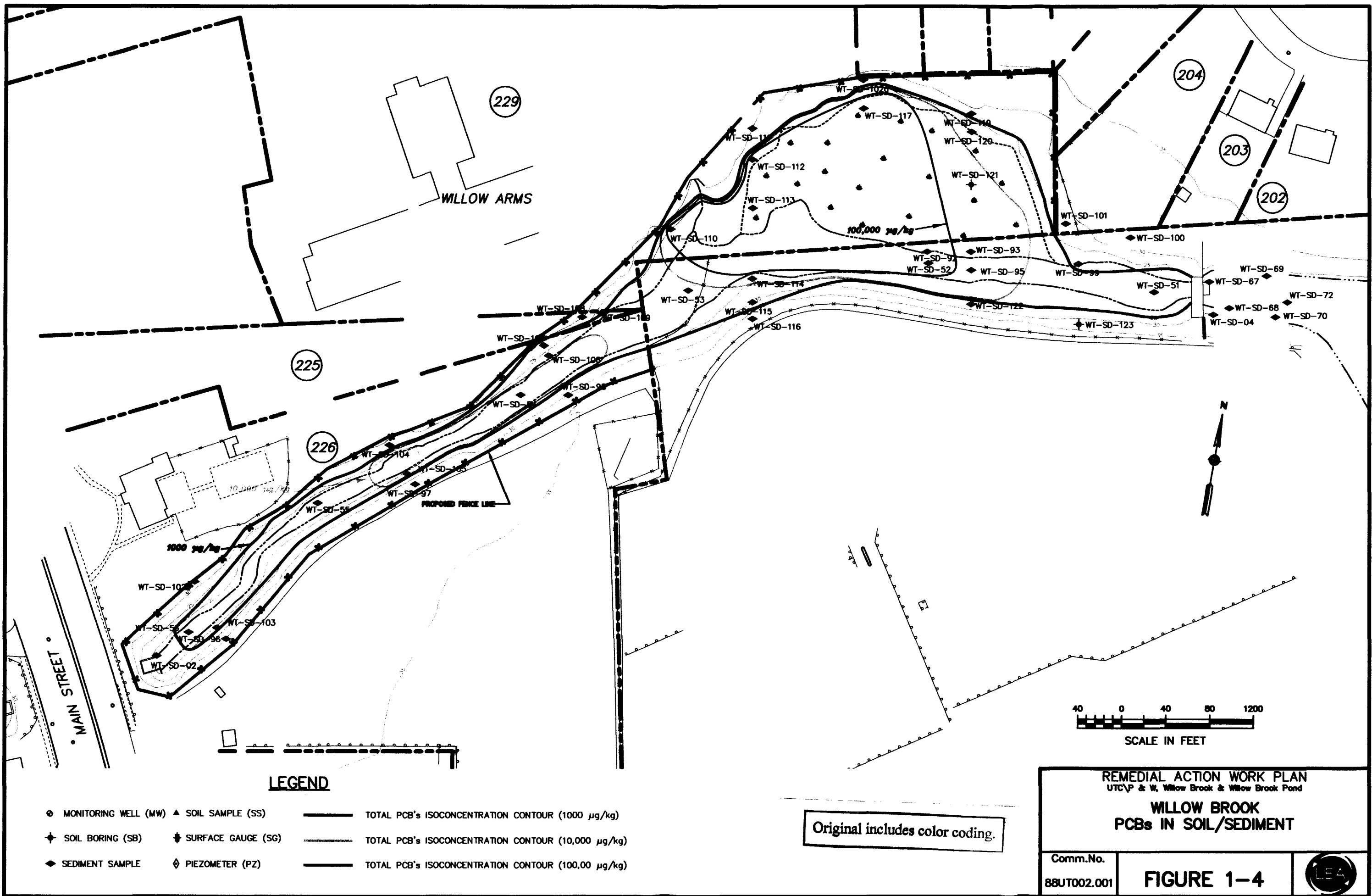
REMEDIAL ACTION WORK PLAN
UTC/V & W, Willow Brook & Willow Brook Pond

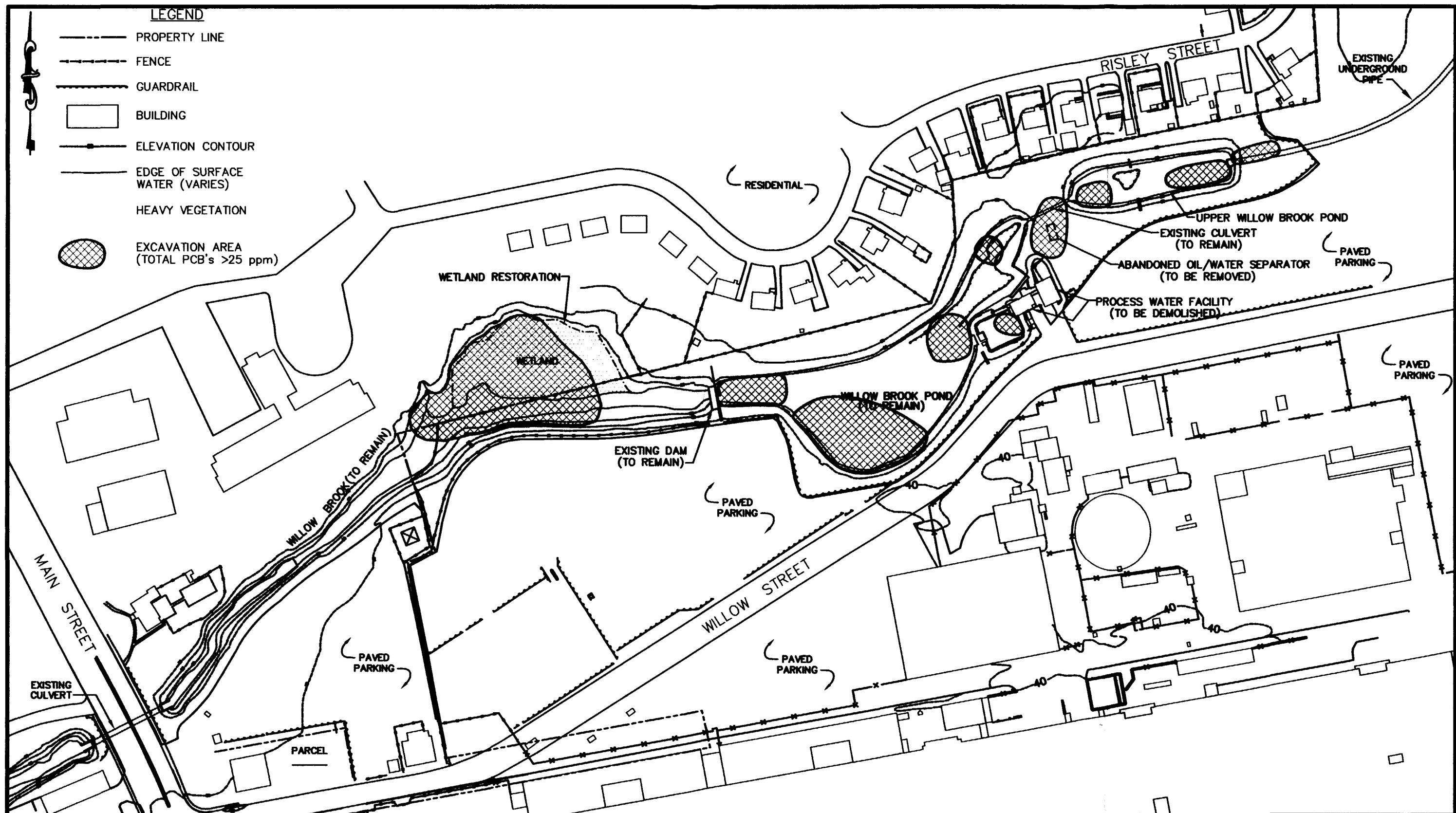
EXISTING SITE PLAN

Comm.No.

88UT002.001

FIGURE 1-2





NOTES:

1. BASE MAP FROM ELECTRONIC FILE OF LOUREIRO ENGINEERING ASSOCIATES, P.C. DRAWING, DATED 12/1/98 AND FROM USGS AERIAL PHOTOGRAPHY, 1994.

Original includes color coding.

REMEDIAL ACTION WORK PLAN
UTC/V & W, Willow Brook & Willow Brook Pond

PROPOSED REMEDIATION ACTIVITIES





Comm.No.
88UT002.001

FIGURE 2-1









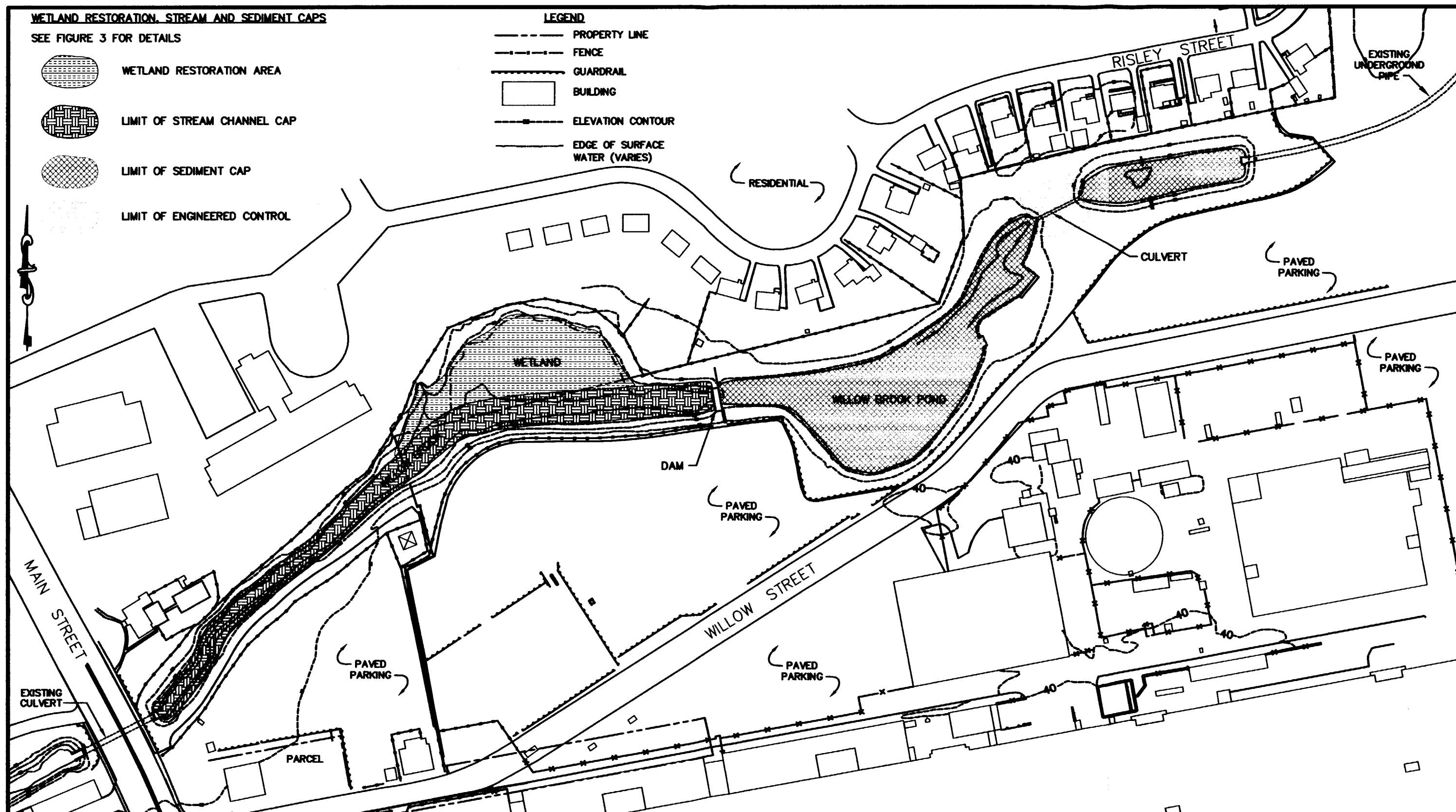
WETLAND RESTORATION, STREAM AND SEDIMENT CAPS

SEE FIGURE 3 FOR DETAILS

-  WETLAND RESTORATION AREA
-  LIMIT OF STREAM CHANNEL CAP
-  LIMIT OF SEDIMENT CAP
-  LIMIT OF ENGINEERED CONTROL

LEGEND

-  PROPERTY LINE
-  FENCE
-  GUARDRAIL
-  BUILDING
-  ELEVATION CONTOUR
-  EDGE OF SURFACE WATER (VARIES)



NOTES

1. BASE MAP FROM ELECTRONIC FILE OF LOUREIRO ENGINEERING ASSOCIATES, P.C. DRAWING, DATED 12/1/98 AND FROM USGS AERIAL PHOTOGRAPHY, 1994.

Original includes color coding.

REMEDIAL ACTION WORK PLAN
UTC/V & W, Willow Brook & Willow Brook Pond

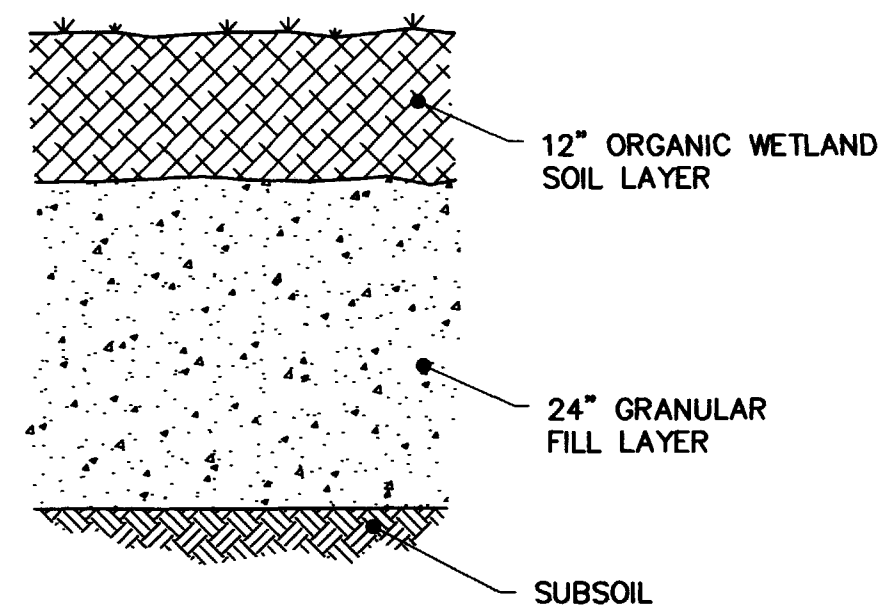
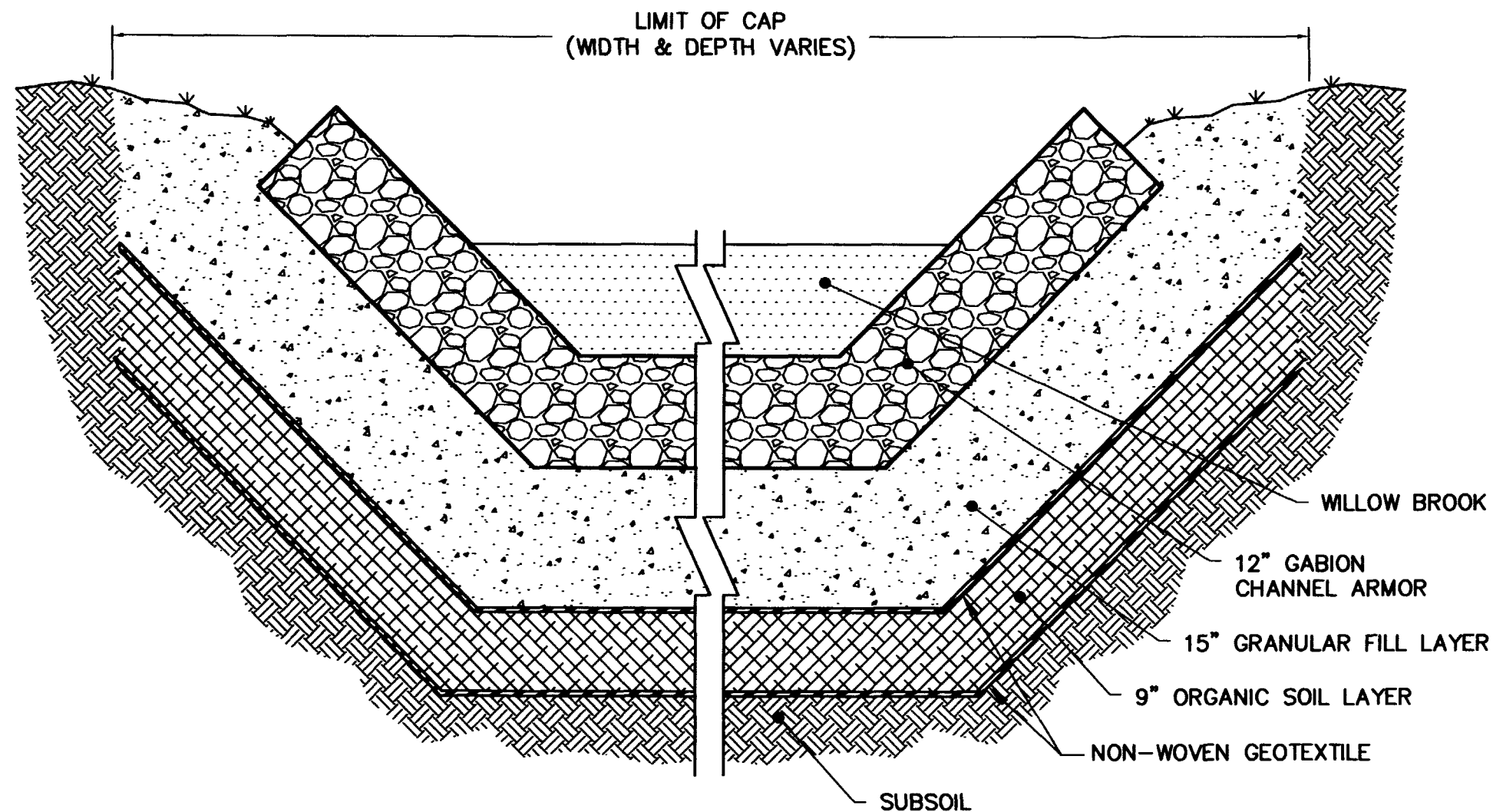
PROPOSED SITE RESTORATION

Comm.No.

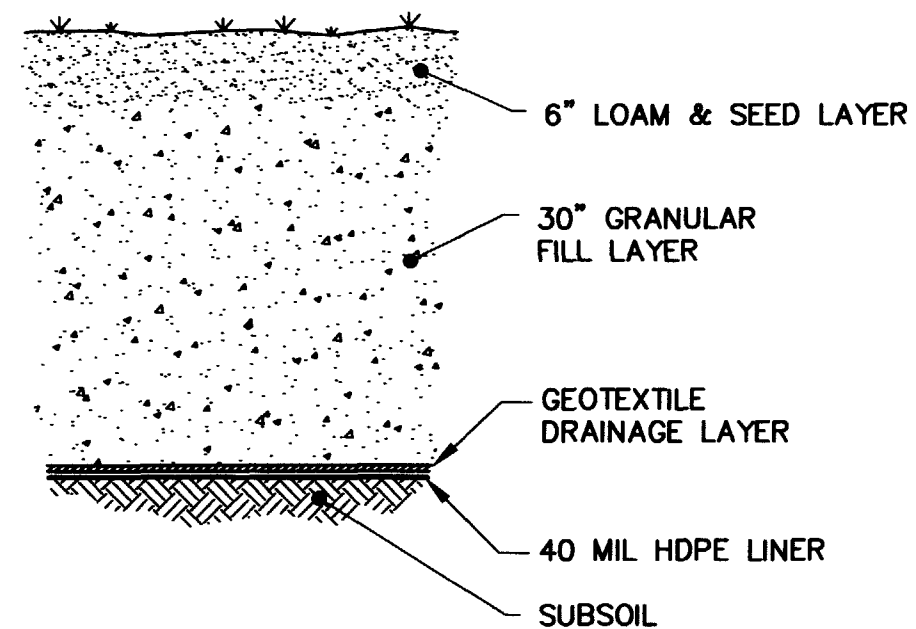
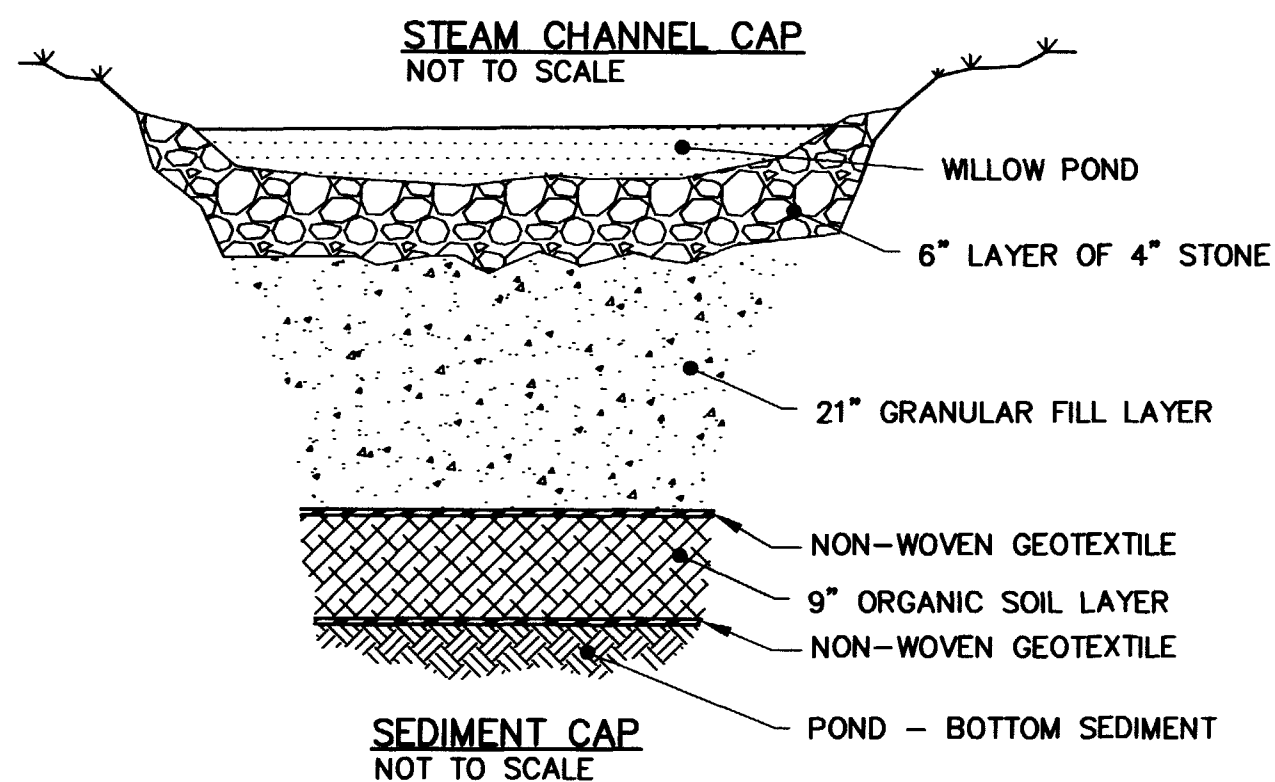
88UT002.001

FIGURE 2-2





WETLAND RESTORATION AREA
NOT TO SCALE



ENGINEERED CONTROL
NOT TO SCALE

REMEDIAL ACTION WORK PLAN UTC/V & W, Willow Brook & Willow Brook Pond	
PROPOSED SITE RESTORATION WETLAND RESTORATION AND CAP DETAILS	
Comm.No. 88UT002.001	FIGURE 2-3

WETLAND RESTORATION, STREAM AND SEDIMENT CAPS

SEE FIGURE 3 FOR DETAILS



WETLAND RESTORATION AREA



LIMIT OF STREAM CHANNEL CAP

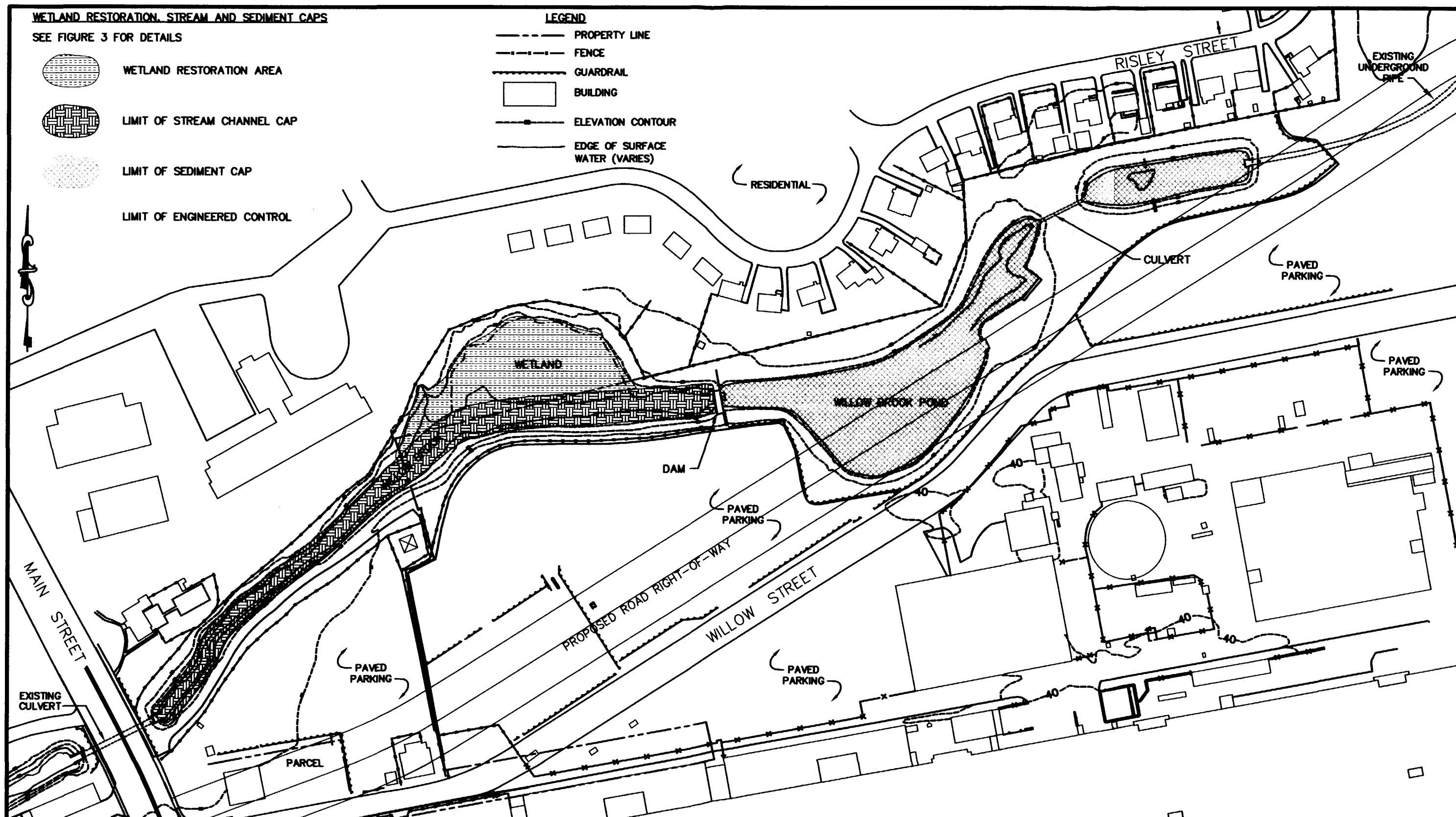


LIMIT OF SEDIMENT CAP

LIMIT OF ENGINEERED CONTROL

LEGEND

- PROPERTY LINE
- - - FENCE
- GUARDRAIL
- BUILDING
- - - ELEVATION CONTOUR
- EDGE OF SURFACE WATER (VARIES)



NOTES:

1. BASE MAP FROM ELECTRONIC FILE OF LOUREIRO ENGINEERING ASSOCIATES, P.C. DRAWING, DATED 12/1/98 AND FROM USGS AERIAL PHOTOGRAPHY, 1994.

Original includes color coding.

REMEDIAL ACTION WORK PLAN
UTC/P & W. Willow Brook & Willow Brook Pond

WILLOW STREET ROADWAY REALIGNMENT

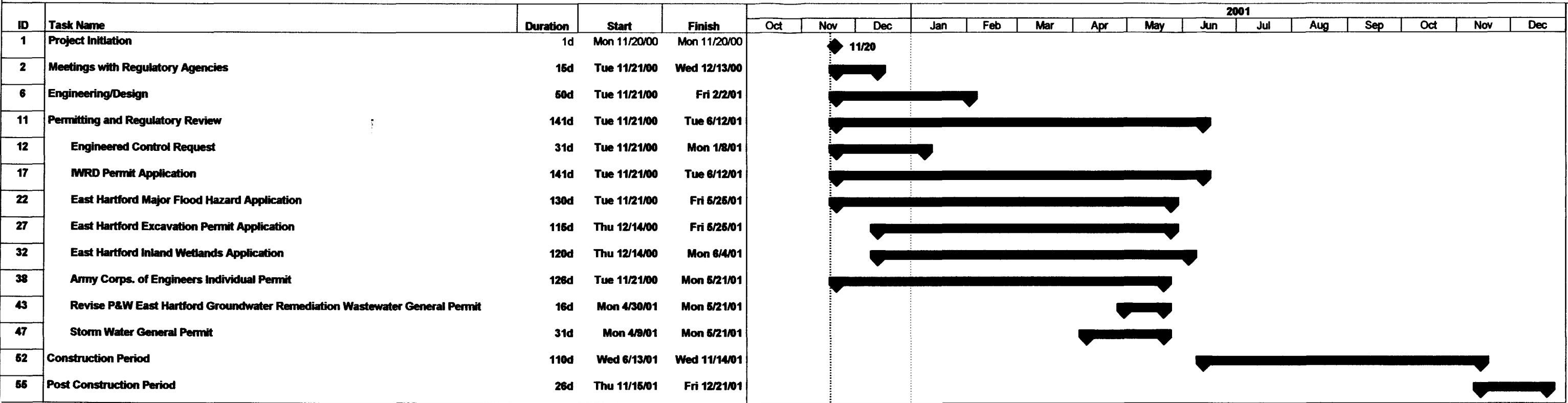
Comm.No.

88UT002.001

FIGURE 2-4



United Technologies Corporation
Pratt & Whitney, East Hartford Facility
Schedule for Willow Brook and Willow Brook Pond Remediation Project



Original includes color coding.

Project: Willow Brook Pond Remediation
Date: Fri 11/17/00

Task
Critical Task

Progress
Milestone


Summary
Rolled Up Task


Rolled Up Critical Task
Rolled Up Milestone


Rolled Up Progress


Schedule Contingent Upon Receipt of Approvals from Town of East Hartford P&Z and Wetlands, ACOE, and DEP within timeframes stipulated.


FIGURE 3-1


Sample ID 1973480
0000100 001 
LEA
LEA VOC Scan
Date: __/__/__ Time: __:__


Sample ID 1973480
0000100 001 
LEA
VOC Scan
Date: __/__/__ Time: __:__


Sample ID 1973481
0000100 001 
LEA
VOC Scan
Date: __/__/__ Time: __:__


Sample ID 1973482
0000100 001 
LEA
LEA VOC Scan
Date: __/__/__ Time: __:__


Sample ID 1973482
0000100 001 
LEA
VOC Scan
Date: __/__/__ Time: __:__


Sample ID 1973482
0000100 001 
LEA
Miscellaneous Analyses
Date: __/__/__ Time: __:__


Sample ID 1973483
0000100 001 
LEA
VOC Scan
Date: __/__/__ Time: __:__


Sample ID 1973483
0000100 001 
LEA
Miscellaneous Analyses
Date: __/__/__ Time: __:__


Sample ID 1973480
0000100 001 
LEA
VOC Scan
Date: __/__/__ Time: __:__


Sample ID 1973481
0000100 001 
LEA
LEA VOC Scan
Date: __/__/__ Time: __:__


Sample ID 1973481
0000100 001 
LEA
VOC Scan
Date: __/__/__ Time: __:__

Sample ID 1973482
0000100 001 
LEA
VOC Scan
Date: __/__/__ Time: __:__

Sample ID 1973482
0000100 001 
LEA
LEA VOC Scan
Date: __/__/__ Time: __:__

Sample ID 1973483
0000100 001 
LEA
LEA VOC Scan
Date: __/__/__ Time: __:__

Sample ID 1973483
0000100 001 
LEA
VOC Scan
Date: __/__/__ Time: __:__

Sample ID 1973483
0000100 001 
LEA
Miscellaneous Analyses
Date: __/__/__ Time: __:__

REMEDIAL ACTION WORK PLAN
UTC/P & W, Willow Brook & Willow Brook Pond

SAMPLE LABELS

Comm.No.
88UT002

FIGURE 4-2



Custody Seal

DATE _____

SIGNATURE

4455 N. 10th Ave.

REMEDIAL ACTION WORK PLAN

UTC/P & W, Willow Brook & Willow Brook Pond

CUSTODY SEAL

Comm.No.

88UT002

FIGURE 4-3



FIELD SAMPLING RECORD
MISCELLANEOUS SAMPLES

LEA Comm. No.: 0000100.001

Project: General Office & Administration

Location: LEA

Client: Loureiro Engineering Associates, PC

Page _____ of _____

Date: / / [illegible]

Samples sent to LEA Laboratory must be accompanied by Form leacust.rpt
Groundwater Samples must be accompanied by Form fedrgl.rpt

Field Personnel:

Signature:

REMEDIAL ACTION WORK PLAN

UTC/P & W, Willow Brook & Willow Brook Pond

FIELD SAMPLING RECORD

Comm.No.

88UT002

FIGURE 4-4





Loureiro Engineering Associates, Inc.
100 Northwest Drive, Plainville, CT 06062 (860) 747-6181

1973480002

Internal Chain of Custody/Sample Information Form

Project Name: _____ Sampling Method: _____
Project Location: _____ Matrix: Soil Vapor Water Other: _____
LEA Comm. No.: _____ Container Type: _____
Project Manager: _____ Sample Source: Monitoring Well / Vapor Probe / Vapor Extraction Well / Soil Boring / Other
Sampling Event Date: ____/____/____ Sampled By: _____

No.	Qty	Sample Number	Time	Mass (gm)	PID/FID Reading	Sample Class	Comments
1							
2							
3							
4							
5							
6							
7							
8							
9							
10							
11							
12							
13							
14							
15							
16							
17							
18							
19							
20							

Signature	Time	Transfer Number	Item Number(s)	Transfer		Date	Time
		Relinquished By		Accepted By			
		1					
		2					
		3					
Additional Comments		4					
		Sample Class Codes:					
		SB: soil - boring or pit - must include depths from ground or floor surface		WP: wipe			
		SS: soil - surface - do not include depth		VP: vapor probe			
		GW: ground water - must include depth from reference mark		BKE: equipment blank		VBKE: vapor equipment blank	
		SW: surface water		BKT: trip blank		VBKT: vapor trip blank	
		SL: sludge		BKF: field blank		VBKF: vapor field blank	
		CC: concrete chip		OT: other - describe in comments			
		AS: asphalt					

Rev.By: _____
least: rpt. Rev.By: _____

Comm. No.
88UT002

FIGURE 4-5



SAMPLE CHAIN OF CUSTODY

REMEDIAL ACTION WORK PLAN
UTC/P & W. Vance Brook & Willow Brook Pond

Appendix A

Summary of Historical Analytical Results

**US EPA New England
RCRA Document Management System (RDMS)
Image Target Sheet**

RDMS Document ID# 1107

Facility Name: PRATT & WHITNEY (MAIN STREET)

Phase Classification: R-12

**Document Title: REMEDIAL ACTION WORK PLAN -
WILLOW BROOK AND WILLOW BROOK POND**

Date of Document: 11/01/2000

Document Type: WORK PLAN

Purpose of Target Sheet:

☒ **Oversized**

☐ **Privileged**

☐ **Page(s) Missing**

☐ **Other (Please Provide Purpose
Below)**

Comments:

**DRAWING 1: ANALYTICAL DATA & SAMPLING
LOCATIONS - WILLOW BROOK POND**

*** Please Contact the EPA New England RCRA Records Center to View This Document ***

**US EPA New England
RCRA Document Management System (RDMS)
Image Target Sheet**

RDMS Document ID# 1107

Facility Name: PRATT & WHITNEY (MAIN STREET)

Phase Classification: R-12

**Document Title: REMEDIAL ACTION WORK PLAN -
WILLOW BROOK AND WILLOW BROOK POND**

Date of Document: 11/01/2000

Document Type: WORK PLAN

Purpose of Target Sheet:

☒ **Oversized** ☐ **Privileged**

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Comments:

**DRAWING 2: ANALYTICAL DATA & SAMPLING
LOCATIONS - WILLOW BROOK**

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**US EPA New England
RCRA Document Management System (RDMS)
Image Target Sheet**

RDMS Document ID# 1107

Facility Name: PRATT & WHITNEY (MAIN STREET)

Phase Classification: R-12

**Document Title: REMEDIAL ACTION WORK PLAN -
WILLOW BROOK AND WILLOW BROOK POND**

Date of Document: 11/01/2000

Document Type: WORK PLAN

Purpose of Target Sheet:

☒ **Oversized** ☐ **Privileged**

☐ **Page(s) Missing** ☐ **Other** (Please Provide Purpose
Below)

Comments:

DRAWING 3: GROUNDWATER DATA - WILLOW POND

*** Please Contact the EPA New England RCRA Records Center to View This Document ***

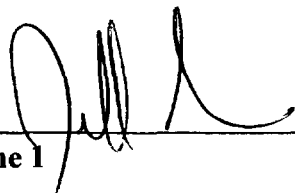
Appendix B

Standard Operating Procedures

**Standard Operating Procedure
for
Hand Auger Borings**

**SOP ID: 10003
Date Initiated: 2/20/90
Revision #005: 6/13/97**

Approved By:



Name 1 **Date** 6-13-97

Gail L. Batchelder

Name 2 **Date** 6/13/97

LOUREIRO ENGINEERING ASSOCIATES

Standard Operating Procedure For Hand Auger Borings

1. Statement of Purpose

This section discusses procedures for conducting hand auger soil borings either for exploration or for the installation of monitoring wells. The procedures provided in this text outline the advancement, decontamination, abandonment, and required documentation for the completion of hand auger borings. This document was prepared in accordance with ASTM D 1452 - 80. Soil sampling for chemical analysis is covered under "STANDARD OPERATING PROCEDURES FOR SOIL SAMPLING."

2. Equipment and Decontamination

2.1. Equipment required for conducting hand auger boring shall include:

- Hand auger (bucket or dutch)
- Auger extensions, wrenches, and handle
- Hand towels
- Portable VOC analyzer (Photovac Microtip® or equivalent)
- Polyethylene plastic sheeting
- Distilled water
- Field documentation
- Indelible marker
- Three 5-gallon buckets
- Alconox detergent, methanol, hexane, nitric acid
- Graduated cylinder
- Analytical balance (accurate to 0.1 gram)
- 500 ml disposable beakers
- Decontamination brushes
- Personal protective equipment
- Clipboard
- Pry bar

operations on a site. The locations of all proposed borings must be clearly marked in the field prior to notification. The site manager **MUST** call and confirm that each utility has been to the site and has marked their respective lines.

2.2.2 Particularly upon larger private sites, consult with the Owner or other person knowledgeable about the site as to locations of potential private or abandoned utilities and locate these prior to beginning work. Upon the discretion of the Project Engineer/Manager, a pipe locator can also be used to assist in locating utilities.

2.2.3 Note that OSHA may have additional requirements for location of utilities.

2.2.4 All efforts to locate underground utilities should be properly documented in the field log book prior to onset of the work scheduled.

2.3 OSHA

The Senior LEA representative shall be the Competent Person required by OSHA for all work. However, this does not relieve other LEA representatives from bringing to his or her attention conditions which may be unsafe or present a hazard to the drilling crew, the general public, or other workers on the site.

2.4 Decontamination

2.4.1 All down-hole and sampling equipment will be sufficiently decontaminated prior to use. Decontamination procedures presented in site specific work plans may vary slightly from those presented below, dependent upon the particular types of contaminants encountered.

2.4.2 A section of 5-mil plastic sheeting shall be cut of sufficient size to underlie the decontamination area to contain any discharge of decontamination solutions.

2.4.3 The following solutions (as appropriate for the anticipated contaminants) shall be prepared and placed in 500-ml laboratory squirt bottles: methanol solution (less than 10% solution); 10% nitric acid solution; 100% hexane solution; and distilled deionized (DI) water. A fifth solution of phosphate-free detergent and tap water (approximately 2.5 gallons) shall be prepared in a five-gallon bucket.

2.4.4 All loose debris shall be removed from the augers and spatulas into an empty 5-gallon bucket or plastic sheeting, using a stiff bristled brush.

2.4.5 The order of decontamination solutions is as follows:

- 1) Detergent Scrub
- 2) DI Water Rinse
- 3) Hexane Rinse (to be used only if separate-phase petroleum product, other than gasoline, is present)
- 4) DI Water Rinse
- 5) 10% Nitric Acid Rinse (to be used only when metals are suspected as potential contaminants)
- 6) DI Water Rinse
- 7) Methanol Rinse (<10% solution)
- 8) Air Dry

2.4.6 Wrap each piece of decontaminated equipment in aluminum foil to maintain cleanliness.

2.4.7 At the end of the project day, all used equipment shall be decontaminated. Dispose of all spent decontamination solutions in accordance with all applicable municipal, state and federal regulations.

2.5 Water

2.5.1 Water is occasionally required to maintain the stability of the boring. If water is used, the source(s), quality, and volume(s) will be recorded on the boring log.

2.5.2 No other drilling fluid, may be used without specific authorization from the Project Manager.

2.6 VOC Monitoring

2.6.1 A portable volatile organic compound (VOC) analyzer shall be available on site and shall be used to screen all cuttings and fluids (if any) removed from the hole.

2.6.2 Since, in general, it cannot be presumed that a site is clean, all cuttings and/or fluids which show a reading on the VOC analyzer above background shall be containerized or drummed, as appropriate, on the site.

Section 3.6 provides additional information on management of potentially contaminated fluids and materials.

- 2.6.3 All health and safety requirements shall be addressed in the Site-Specific Health and Safety Plan for each site.

3.0 Procedure

3.1 Site Preparation

- 3.1.1 A sufficient area shall be cordoned off to restrict access to the work area. This area shall be termed an "Exclusion Zone".
- 3.1.2 An equipment decontamination area shall be assembled, as described in Section 2.4, within the exclusion zone.
- 3.1.3 The area immediately surrounding the proposed borehole shall be covered with 5-mil plastic sheeting (minimum area: 10 square feet). A hole of sufficient diameter shall be cut from the center of the plastic sheeting to facilitate auger advancement.
- 3.1.4 All personal protective equipment shall be donned.
- 3.1.5 Should flooring need to be breached for the advancement of the boring, coring of the floor will be conducted using a concrete coring saw and a wet-dry vacuum to prevent water and cuttings from moving beyond the immediate vicinity of the borehole.

3.2 Auger Advancement

- 3.2.1 Begin the boring by rotating and advancing the auger to the desired depth. Remove the auger and examine the soil for texture, composition, density, moisture and grain-size distribution. Record all information as described in Section 3.4.
- 3.2.2 The soils removed shall be logged in two-foot increments or at each lithologic change.
- 3.2.3 Collect a sufficient aliquot of the soil sample to satisfy all requirements for field and laboratory analysis. A lithologic sample may be required and should be obtained into a 4-ounce soil jar. The procedures for collection

of soil samples for chemical analysis are described in the *Standard Operating Procedures for Soil Sampling*.

- 3.2.4 Discard boring spoils into the appropriate containers or onto the plastic sheeting for later disposal.

3.3 Field Analysis

- 3.3.1 The probe used to detect VOCs shall be either a Photovac Microtip® photoionization detector or a Foxboro OVA® flame ionization detector or equivalent and calibrated in accordance with the instructions provided in Attachment A to this SOP. Calibration shall be performed, at a minimum, prior to each sampling event and checked after each day of sampling.

- 3.3.2 The following procedure shall be used to obtain readings of the VOCs present in a soil sample:

- 1) Obtain an aliquot of soil (approximately 50 grams) from the bottom of the auger and place it into a Ziploc® plastic bag or equivalent and seal.
- 2) Agitate the sample, assuring that all soil aggregates are broken, for two minutes.
- 3) Carefully break the seal of the bag enough to insert the VOC probe.
- 4) Record the maximum reading obtained on the appropriate forms, as described in Section 3.4.

3.4 Field Documentation

- 3.4.1 The following general information shall be recorded in the field log book and/or the appropriate field form(s).

- Project and site identification
- LEA commission number
- Field personnel
- Name of recorder
- Identification of borings
- Collection method
- Date and time of collection

- Types of sample containers used, sample identification numbers and QA/QC sample identification
- Field analysis method(s)
- Field observations of sampling event
- Name of collector
- Climatic conditions, including air temperature
- Chronological events of the day
- Status of total production
- Record of non-productive time
- QA/QC data
- Location of boring(s) on site in sufficient detail to relocate boring at a future time (include sketch)

3.4.2 The following information shall be recorded on the boring log:

- Project name, location, and LEA commission number
- Borehole number, borehole diameter, boring location, drilling method, field crew performing work, groundwater observations, logger's name and date
- Depth below grade, sample I.D. number, duplicate numbers, VOC analyzer reading
- A complete sample description, including as a minimum: depth, material size gradation using the Burmeister system, color, moisture, and density
- Should a well be constructed in a bore hole, a complete well schematic shall be drawn and accurately labeled
- Use of water, including source(s) and quantity

3.4.3 The following information shall be recorded on the Field Quality Review Checklist:

- Reviewer's name, date, and LEA commission number
- Review of all necessary site activities and field forms
- Statement of corrective actions for deficiencies

3.4.4 The Field Instrument & Quality Assurance Record shall include the following information:

- Client's name, location, LEA commission number, date
- Instrument make, model, and type
- Calibration readings
- Calibration/filtration lot numbers
- Field personnel and signature

3.5 Disposal of Potentially Contaminated Materials

- 3.5.1 Potentially contaminated cuttings or fluids, as indicated by knowledge of the site, discoloration, VOC analyzer readings, or other evidence, shall be containerized on the site pending sampling and determination of hazardous waste status.

3.6 Boring Abandonment

- 3.6.1 If the boring is not to be used for other purposes (i.e. monitoring well, soil vapor probe, soil vapor extraction well, etc.), it shall be abandoned.
- 3.6.2 The boring shall be filled and sealed with neat cement grout, or high-density bentonite clay grout.
- 3.6.3 Excess cuttings shall be containerized and sampled before disposal.
- 3.6.4 In paved areas, the upper three feet of the borehole shall be filled, up to two inches below the existing grade, with sand to allow for repairing of the pavement.
- 3.6.5 Pavement shall be repaired using cold patch asphalt filler or concrete.

4.0 Other

Depending on the specific site, other considerations may be applicable. Consult the OSHA regulations, applicable RCRA or CERCLA regulations, and the site-specific work plan for details.

**Standard Operating Procedure
for
Liquid Sample Collection and Field Analysis**

SOP ID: 10004

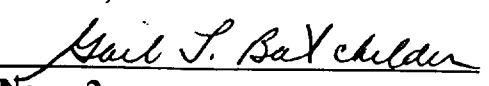
Date Initiated: 2/20/90

Revision #004 : 06/12/97

Approved By:



Name 1 Date 6-17-97



Name 2 Date 6/17/97

LOUREIRO ENGINEERING ASSOCIATES

Standard Operating Procedure For Liquid Sample Collection and Field Analysis

1.0 Statement of Purpose

This document describes procedures to be followed for measurement of static water level elevations, detection of immiscible layers, well evacuation, sample withdrawal, and field analyses.

2.0 Equipment and Decontamination

2.1 Equipment required for the collection and field analysis of liquid samples shall include:

- water-level indicator (accurate to 0.01 foot)
- distilled water
- hand towels
- portable VOC analyzer (Photovac Microtip®, Foxboro OVA® or equivalent)
- interface probe, clear PVC or fluorocarbon resin bailer
- pH and temperature meter (capable of accuracy to 0.1 pH unit)
- specific conductance meter
- two-inch diameter, fluorocarbon resin or stainless steel bailers (clean) with disposable nylon or polyethylene rope
- polyethylene plastic sheeting
- centrifugal pump with fluorocarbon resin foot valve, peristaltic pump and polyethylene tubing, or other appropriate pumping apparatus
- clean disposable gloves
- Alconox®, or other non-phosphate laboratory grade detergent
- Three 5-gallon buckets
- Decontamination brushes
- Distilled, de-ionized water
- Decontamination fluids (< 10% methanol in water, 100% n-hexane, and 10% nitric acid)

2.2 Equipment Decontamination

All materials and equipment which enter a well must be clean and free of any potential contaminants. In general, the choice of decontamination procedures

should be based upon a knowledge of the site-specific contaminants and outlined in the site-specific work plan.

For sites at which the contaminants are unknown, but contamination is suspected, the decontamination procedures outlined below should be followed.

- 2.2.1 Prior to commencing any field activities, the following solutions (as appropriate for the appropriate contaminants) should be prepared and placed into 500-ml laboratory squirt bottles: 10% methanol in water; 10% nitric acid in water; 100% n-hexane; distilled, de-ionized water.
- 2.2.2 In the field, prepare approximately 2.5 gallons of a solution of Alconox® (or other suitable non-phosphate laboratory grade detergent) in tap water in a 5-gallon bucket.
- 2.2.3 Prepare a piece of 5-mil polyethylene sheeting to underlie the decontamination area. The sheeting should be of sufficient size to contain any accidental discharge of decontamination solutions. The plastic should be bermed to contain spills.
- 2.2.4 The order for decontaminating equipment is as follows:
 - 1) Detergent scrub
 - 2) DI water rinse
 - 3) Hexane rinse (to be used only if separate-phase petroleum product, other than gasoline, is present)
 - 4) DI water rinse
 - 5) 10% nitric acid rinse (to be used only when metals are suspected as potential contaminants)
 - 6) DI water rinse
 - 7) Methanol rinse (<10% solution)
 - 8) Air dry
- 2.2.5 Materials such as the cord should not be decontaminated and should just be disposed of after each test.
- 2.2.6 Wrap each piece of decontaminated equipment in aluminum foil, as appropriate, to maintain cleanliness.
- 2.2.7 At the end of the project day, dispose of all spent decontamination fluids and materials such as the polyethylene sheeting and personal protective

equipment in accordance with all applicable municipal, state, and federal regulations.

3.0 Sample Collection

3.1 Measurement of Static Water Level

- 3.1.1 The static water elevations in each well shall be measured prior to each sampling event. This is performed initially to characterize the site, and in subsequent sampling rounds to determine whether horizontal or vertical flow gradients have changed. A change in hydrologic conditions may necessitate modification of the groundwater monitoring program.
- 3.1.2 Remove the protective cover and locking cap.
- 3.1.3 The air in the well head will be sampled for volatile organic compounds (VOCs) using a portable VOC analyzer, such as a Photovac Microtip®. The instrument shall be zeroed with ambient air prior to the measurement, and the initial and final readings shall be recorded for each well.
- 3.1.4 Each well shall have a surveyed reference point located at the top of the well casing with the locking cap removed. The reference point shall be easily recognizable, since the personnel conducting the sampling may differ from one sampling event to the next.
- 3.1.5 The following parameters shall be measured with an accuracy of 0.01 ft:
 - depth to standing water
 - depth to bottom of well
- 3.1.6 A water-level indicator with a fiberglass tape will be used for measurement. Due to possible pressure differences between the well atmosphere and the ambient atmosphere, the water level will be allowed fifteen minutes to equilibrate upon removal of the well cap. The results shall be recorded on the appropriate field form(s).
- 3.1.7 Total depth measurements will be compared to original depths to determine the degree of siltation that may have occurred. This information shall be noted on the field form. Should significant siltation occur in any well, the well shall be redeveloped by an approved method.

- 3.1.8 The portion of the tape immersed in the well shall be decontaminated during retrieval using a distilled water rinse followed by drying with a clean wipe, prior to use in another well. This decontamination procedure shall be amended, as needed, to accommodate the specific type of contamination anticipated.

3.2 Detection of Immiscible Layers

- 3.2.1 Should evidence warrant, a sampling event shall include provisions for detection of immiscible phases prior to well evacuation or sample collection. Light non-aqueous phase liquids (LNAPLs) are relatively insoluble liquid organic compounds with densities less than that of water (1 g/ml), while dense non-aqueous phase liquids (DNAPLs) are organic compounds with densities greater than that of water. Lighter and/or denser immiscible phases may be encountered in a groundwater monitoring well.
- 3.2.2 An interface probe will be used to determine the existence of any immiscible layers, light or dense. Alternatively, a clear fluorocarbon resin or PVC bailer may be used to determine the existence of the phases or oil sheen in the well when no accurate determination of the immiscible layer thickness is required.
- 3.2.3 Should elevations of the immiscible layers be required, levels of the fluids shall be measured to an accuracy of 0.02 feet using an electronic interface probe capable of detecting the interfaces between air, product, and water. The interface levels shall be recorded in the field notebook. Adjustments of the observed head to the theoretical hydraulic head shall be calculated based on the density conversion factor associated with the particular non-aqueous phase liquid.
- 3.2.4 The immiscible layers and groundwater shall then be purged into 55-gallon 17H DOT drum which shall be labeled and characterized for disposal.

3.3 Field Analysis

- 3.3.1 Parameters that are physically or chemically unstable shall be tested immediately after collection using a field test kit or other equipment. Such parameters as pH, temperature, and specific conductance will be measured in the field, at the temperature of the well sample.
- 3.3.2 A standard pH meter with a glass or polymer-body electrode (Orion pH Meter model SA 250 or equivalent) shall be used. The meter shall be

calibrated prior to use using two buffer solutions, in accordance with the instructions included in Attachment A to this SOP. Calibration shall be checked using the two buffer solutions prior to sampling each well. Calibration information to be recorded in the field log will be the temperature and pH readings in each buffer before and after each calibration. The date the buffer was prepared shall also be noted in the field notebook.

The temperature and pH probes shall be placed into a sample and allowed to stabilize for a minimum of twenty seconds. The accuracy of measurement shall be 0.1 pH units and 0.1° Celsius. The sample shall be discarded in an appropriate manner upon completion of analysis.

- 3.3.3 Specific conductance will be measured using Cole-Parmer Conductivity Meter model 1481-55 or equivalent that has been calibrated in accordance with the instructions provided in Attachment A to this SOP. Calibration shall be performed prior to each sampling event and checked after each day of sampling.

The specific conductance probe shall be added to the sample container following measurement of the pH and temperature. The conductance meter will be adjusted for the temperature of the sample. Twenty seconds shall be allowed for stabilization prior to obtaining a reading. Accuracy shall be as stipulated by the range of the instrument.

- 3.3.4 These probes shall be decontaminated using a distilled/deionized water rinse between each sample. To the extent possible, the same probe and meter shall be used for all measurements at a given site for the duration of monitoring at the site.

3.4 Well Evacuation

- 3.4.1 Calculate standing water in the well based on the following schedule and record on the appropriate field form:

Well Diameter (inches)	Conversion Factor (gal/feet)
2	0.163
4	0.654
6	1.47

- 3.4.2 Generally, a centrifugal, submersible, air-lift, bladder, inertial, or peristaltic pump equipped with a flouorocarbon resin or PVC foot valve on the end of dedicated tubing, as appropriate, may be used to evacuate the monitoring wells. Alternatively, evacuation of the wells may be accomplished using a bailer.
- 3.4.3 A new piece of polyethylene plastic shall be placed on the ground adjacent to the well. Sampling and purging equipment, such as pump, tubing, bailers and bailer twine, containers, etc., shall be placed on the polyethylene sheet, never on the ground.
- 3.4.4 Don disposable gloves, prepare pump and tubing for insertion into the well, ensuring that any tubing or pump apparatus is of sufficient length to reach the appropriate depth for pumping.
- 3.4.5 Lower the pump and/or tubing gently into the water column and begin pumping.
- 3.4.6 Measure pH, temperature and specific conductance in the well from the first water extracted during the purging process.
- 3.4.7 Remove a volume of water equal to 3 to 5 times the standing water from the well measured in a 5-gallon bucket.
- 3.4.8 If it is not possible to remove three volumes as described above, due to slow recovery of the well, the well shall be emptied and allowed to recover. Samples obtained from slow-yielding wells shall be extracted as soon as a sufficient volume is available for a sample for each parameter.
- 3.4.9 Measure pH, temperature, specific conductance prior to sampling.
- 3.4.10 Well evacuation is deemed to be complete when the following criteria have been met:
- pH measurements vary no more than ± 0.5 standard units
 - specific conductance measurements vary no more than $\pm 10\%$
 - temperature measurements vary no more than $\pm 1^{\circ}\text{C}$
 - turbidity measurements (if used) are below 5 NTU, if practicable
- or a maximum of five well volumes have been removed from the well

- 3.4.11 Measure pH, temperature, specific conductance again after sampling to determine effectiveness of purging and sample stability.
- 3.4.12 Do not re-use purging equipment (bailers, rope, tubing, sampling vials, etc.). Any non-disposable bailers shall be returned to the office for decontamination. Pumps shall be decontaminated between monitoring wells, in accordance with procedures noted in Section 2.2
- 3.4.13 Bailer twine and other consumables, such as filter apparatus, shall be disposed of appropriately.
- 3.4.14 Record sampler's name, sampling time, volume of water purged, parameters measured, weather conditions, sample number, analyses required and all other pertinent information in field notebook and/or appropriate field forms, and complete the chain of custody form.
- 3.4.15 Any water purged from the monitoring wells shall be stored in appropriate containers until the laboratory analyses are available. Then it should be disposed of in accordance with all applicable local, state and federal requirements.
- 3.4.16 Storage shall be in containers approved for storage of hazardous materials, and in an appropriate designated location at the facility.

3.5 Sample Withdrawal

- 3.5.1 In order to ensure that the groundwater sample is representative of the formation, it is important to minimize physical alteration (i.e. agitation during purging and/or sample collection) or chemical contamination of the sample during the withdrawal process. The sample set shall include enough dedicated bailers to obtain samples from each well, plus 10%.
- 3.5.2 Use either an appropriate pump or fluorocarbon resin or stainless steel bailer to purge each well (the same pump used for purging may be used for sample withdrawal, with the exception that samples intended for VOC analysis must be collected using either a bailer or a bladder pump.). Do not reuse a bailer in the field; used bailers shall be returned to the office for decontamination.

3.5.3 To minimize agitation of the water column, samples shall be collected from the pump tubing in the following order into pre-labeled sample containers:

- Extractable organics (semi-volatile)
- Total petroleum hydrocarbons
- PCBs
- Metals
- Phenols
- Cyanide
- Chloride and sulfate
- Nitrate and ammonia
- Turbidity
- Radionuclides

Samples to be analyzed for the following constituents shall be collected using a bailer, after any pump and tubing have been removed from the well. Removal of any downhole equipment should be done carefully and in a manner that minimizes disturbance of the water column.

- Volatile organic compounds (VOCs)
- Purgeable organic carbon (POCs)
- Purgeable organic halogens (POX)
- Total organic halogens (TOX)
- Total organic carbon (TOC)

3.5.4 Samples shall be obtained from the monitoring wells as soon as possible after purging. This may require waiting an extended period for low-yielding wells.

3.5.5 Samples collected for VOC analysis shall be free of any air bubbles and inverted upon filling. Bacterial samples shall be collected using dedicated gloves; taking care not to allow anything to touch the inside of the sampling container.

3.5.6 Samples collected for dissolved metals analysis, which are to be filtered in the field, shall be passed through a 0.45 micron (maximum) filter (either in-line or under negative pressure) prior to placement in the sample bottle.

3.5.7 In situations where replicate samples shall be required, care shall be taken to ensure that each sample collected is independent.

3.5.8 In some situations, inorganic parameters may be sampled directly from a pump after completion of well evacuation procedures.

3.6 Field Documentation

3.6.1 Field documentation shall include at a minimum: a chain-of-custody form, Field Data Record Groundwater Form, Sample Collection Form, Daily Field Report, Field Quality Review Checklist. Sample labels and sample seals shall be used for proper sample identification.

3.6.1.1 The labels shall be sufficiently durable to withstand immersion for 48 hours without detaching and to withstand normal handling. The information provided shall be legible at all times.

3.6.1.2 The following information shall be provided on the sample label using an indelible pen:

- Sample identification number
- Date and time of collection
- Place of collection
- Parameter(s) requested (if space permits)

3.6.1.3 A field logbook and/or appropriate field forms will be used to log all pertinent information with an indelible pen. The following information shall be provided:

- Identification of well
- Static water level measurement technique
- Presence of immiscible layers and detection method
- Time well purged
- Collection method for immiscible layers and sample identification numbers
- Well evacuation procedure/equipment
- Sample withdrawal procedure/equipment
- Date and time of collection
- Types of sample containers used and sample identification numbers
- Preservative(s) used
- Parameters requested for analysis

- Field analysis method(s)
- Whether or not field filtration was performed and the filter size, if appropriate
- Field observations on day of sampling event
- Record of site activities
- Name of collector
- Climatic conditions, including air temperature
- Status of total production

3.6.1.4 The Field Sampling Record shall include at a minimum the following information:

- Identification of well
- Date and time of collection
- Name of collector
- Sample number

3.6.1.5 The chain-of-custody record shall include the following information:

- Company's name and location
- Date and time of collection
- Sample number
- Container type, number, size
- Preservative used
- Signature of collector
- Signatures of persons involved in the chain of possession
- Analyses to be performed
- Project and site location
- Inspectors and time of inspection
- Record of non-productive time
- Type and number of samples, total number of sample bottles, and sampling method

3.6.1.6 The Field Data Record Groundwater Form shall be updated during the sampling of each well and include the following information:

- Identification of well
- Well depth, diameter, depth to water

- Static water level depth and measurement technique
- Purge volume and pumping rate
- Time well purged
- LEA commission number
- Date

3.6.1.7 The Field Quality Review Checklist shall assure the completeness of the sampling round and include the following information:

- Reviewer's name, date, and LEA commission number
- Review of all necessary site activities and field forms
- Statement of corrective actions for deficiencies

ATTACHMENT A
Calibration Procedures

pH MEASUREMENTS

MEASUREMENT PROCEDURES

pH Measurements

See **Figure 6**.

A calibration with one or two buffers should be performed before pH is measured. It is recommended that a calibration with two buffers be performed at the beginning of each day to determine the correct slope of the electrode. This serves the dual purpose of determining if the electrode is working properly and storing the slope value in the meter's memory. Perform a one buffer calibration every two hours to compensate for electrode drift.

Check the stored value for **ISO** before calibration. Unless the isopotential point of the electrode is known verify that the display reads **7.00**. If not, scroll until **7.00** is displayed and press **enter**. See **Isopotential Point**.

There are two ways of calibrating the SA 250 Meter, autocalibration or manual calibration.

NOTE: It is recommended to select either autocalibration or manual calibration and not use a combination of the two methods. Following is a description and instructions for each method.

Autocalibration

Autocalibration is a feature of the SA 250 Meter that automatically recognizes the 7.00, 4.01 and 10.01 buffers with a range of ± 0.5 pH units. The user waits until the pH display is stable and presses **enter**. The SA 250 Meter automatically calibrates to the correct buffer value using temperature compensation. Do not scroll when using autocalibration.

While calibrating, the SA 250 Meter compares actual values to theoretical values to determine if the buffer is within range. Buffers greater than ± 0.5 pH units from the correct value will trigger an operator assistance code.

It is recommended that an ATC probe be used for autocalibration. If an ATC probe is not used, all samples and buffers should be at the same temperature or use manual temperature compensation. See **Temperature Mode**.

Autocalibration With Two Buffers

1. Connect electrode(s) to meter. Slide the **mode** switch to either **pH .1** or **pH .01**. Choose either 4.01 and 7.00, or 7.00 and 10.01 buffers, whichever will bracket your expected sample range.
2. Place electrode(s) into either 4.01, 7.00 or 10.01 buffer.
3. Press **cal**. The display will alternate between **.1**, and the pH value of the buffer, indicating this is the first buffer and a value has not been entered. Wait for a stable pH display and press **enter**. The correct display will freeze for 3 seconds then advance to **.2**, indicating the meter is ready for the second buffer.

4. Rinse electrode(s) and place into a second buffer. Wait for a stable pH display and press **enter**.

After the second buffer value has been entered the letters **PH** will be displayed. The meter is now calibrated and automatically advances to **sample** mode.

5. Rinse electrode(s), place into sample. Record pH directly from the meter's display.

Autocalibration With One Buffer

1. Check slope term by pressing **slope**. If necessary, scroll and enter the correct value. If slope value is unknown, either enter 100.0 or perform a two buffer calibration. A single buffer calibration does not change the slope term.
2. Connect electrode(s) to meter. Slide **mode** switch to either **pH .1** or **pH .01**.
3. Place electrodes into either 4.01, 7.00 or 10.01 buffer:
4. Press **cal**. The display will alternate between **.1**, and the pH value of the buffer, indicating this is the first buffer and a value has not been entered.
5. Wait for a stable pH reading and press **enter**.

After **enter** is pressed the correct display will freeze for 3 seconds then advance to **.2**, indicating the meter is ready for the second buffer. By pressing **sample** the letters **PH** will be displayed, indicating the meter has advanced into the sample mode.

6. Rinse electrode(s) and place into sample. Read the pH directly from the display.

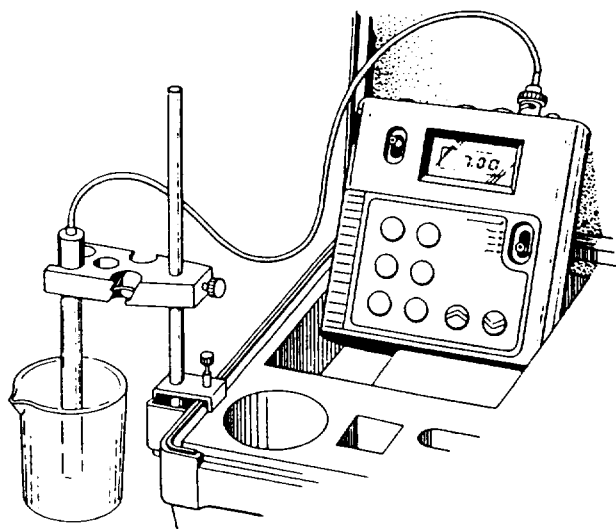


Figure 6
Optional Way to Set Up SA 250 Meter
for Sample Measurements

Manual Calibration

To calibrate with buffers other than 4.01, 7.00 or 10.01, use the manual calibration technique. The calibration sequence is the same as autocalibration, except buffer values are scrolled in.

It is recommended that an ATC probe be used. If an ATC probe is not used, all samples and buffers should be the same temperature or use manual temperature compensation. See **Temperature Mode**.

NOTE: Even if scrolling is not necessary, scroll one digit and return to correct value before pressing enter. Otherwise meter will assume autocalibration is to be used.

Manual Calibration With Two Buffers

1. Connect electrode(s) to meter. Slide **mode switch** to either pH .1 or pH .01. Choose two buffers that will bracket your expected sample range.
2. Place electrode(s) into the first buffer.
3. Press **cal**. The display will alternate between **.1** and the pH value of the buffer, indicating this is the first buffer and a value has not been entered.
4. Wait for a stable pH display. Using \wedge , \vee or **X10** keys, scroll in the correct value and press **enter**.

The display will freeze for 3 seconds then advance to **.2**, indicating the meter is ready for the second buffer.

5. Rinse electrode(s) and place into the second buffer. Wait for a stable pH display. Scroll in the correct value and press **enter**.

After the second buffer value has been entered the letters **PH** will be displayed. The meter is now calibrated and automatically advances to the **sample mode**.

6. Rinse electrode(s) and place into sample. Record pH directly from the meter's display.

Manual Calibration With One Buffer

1. Verify slope by pressing **slope**. If necessary scroll in correct value, using \wedge , \vee and **X10** keys, and press **enter**. If correct slope is unknown, either enter **100.0** or perform a two buffer calibration.
2. Connect electrode(s) to meter. Slide **mode switch** to either pH .1 or pH .01.
3. Place electrodes into the buffer.
4. Press **cal**. The display will alternate between **.1** and the pH value of the standard, indicating this is the first buffer and a value has not been entered.

Wait for a stable pH display, scroll until the correct value is displayed and press **enter**.

The display will freeze for 3 seconds then advance to **.2**, indicating the meter is ready for the second buffer. By pressing **sample** the letters **PH** will be displayed. The meter is now calibrated and automatically advances to **sample mode**.

5. Rinse electrode(s) and place into sample. Read the pH directly from the display.

NOTE FOR MANUAL CALIBRATION: In the event that scrolling was started but the value was not entered and the mode switch was changed, either a P1 or a P2 will be displayed upon returning to the pH mode. P1 indicates that a value has not been entered for the first buffer while P2 indicates a value has not been entered for the second buffer.

Slope

By pressing the **slope** key the slope is displayed as a percent of theoretical. A properly functioning electrode will have a 92% to 102% slope. See **Troubleshooting**, if the slope is out of range. The slope value is retained in the meter's memory until another two buffer calibration is performed or another value is entered. A one buffer calibration does not change the slope value.

At the beginning of each day and every time a different electrode is used a two buffer calibration should be performed for accurate measurements.

To enter a slope value:

1. Slide the **mode switch** to either pH .1 or pH .01.
2. Press the **slope** key.
3. Scroll, using \wedge , \vee or **X10** keys, until the correct value is displayed.
4. Press **enter**.

ORION SA 250 pH METER

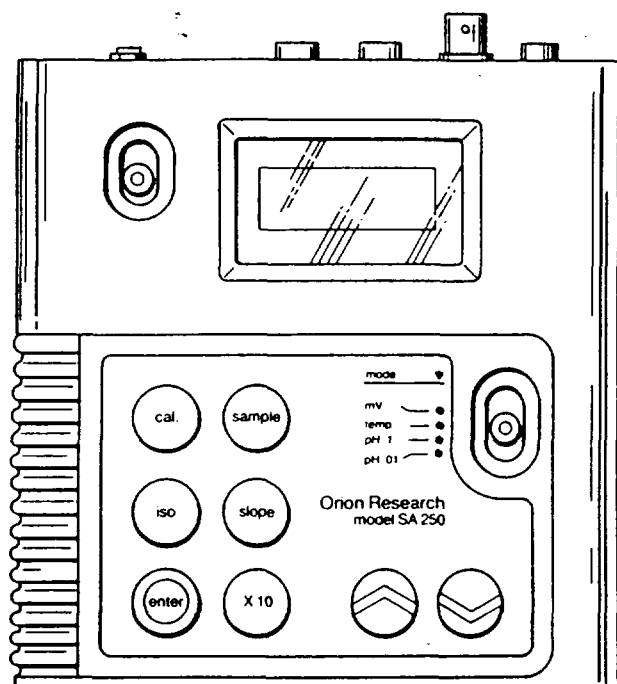
Autocalibration With Two Buffers and an ATC Probe

Select either 4.01 and 7.00, or 7.00 and 10.01 buffers, whichever will bracket the expected sample range.

An ATC probe is used for convenience and accuracy. Once the ATC probe is plugged into the input jacks, and placed into solution, entering temperature values manually is not possible. The ATC probe automatically senses buffer or sample temperature for use in calculating accurate pH values.

1. Connect electrodes and ATC probe to meter.
2. Select pH mode and resolution by sliding the **mode** switch to **pH .1** or **pH .01**.
3. Press **iso** and verify that the isopotential point is **7.00**.
4. Place electrodes and ATC probe into **7.00** buffer.
5. Press **cal**. The display will alternate between **.1.** and the pH value of the buffer, indicating that the electrodes are in the first buffer and a value has not yet been entered.
6. Wait for the pH value to stabilize. Press **enter**. The correct display will freeze for 3 seconds, then advance to **.2.**, indicating the meter is ready for the second buffer.
7. Rinse electrodes and ATC probe and place into the second buffer, either 4.01 or 10.01. The display will alternate between **.2.** and the pH value of the buffer.
8. Wait for the pH value to stabilize. Press **enter**. The letters **pH** will be displayed. The SA 250 Meter is now calibrated and automatically advances into the sample mode.
9. Rinse electrodes and ATC probe and place into sample. Read the pH directly from the display.

NOTE: A different isopotential point can be entered. However, if you do not know the isopotential point of your pH electrode, the 7.00 default setting is recommended for Ag/AgCl and ROSS pH Electrodes.



ORION

Orion Research Incorporated
Laboratory Products Group

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FÄHNLIBRUNNENSTRASSE 3

CH-8700 KÜSNACHT, SWITZERLAND

TEL 01 910 7858 / TLX 825767

OPERATING INSTRUCTIONS

CORNING

PS-15 pH METER

CATALOG NUMBER 475810

SPECIFICATIONS

Range: 0.0 - 14.0 pH

Accuracy: ± 0.2 pH

Resolution: 0.1 pH

Operating Temperature: 0 to 50°C

Battery: 3 x 1.4 V

(Duracell MP675H or equivalent)

Battery Life: 1000 hours

Size (L x W x H):

154 mm x 29 mm x 16 mm

Weight: 65 grams

OPERATION (refer to figure 1)

1. Remove protective cap from the bottom of the meter.

2. Turn on meter using ON/OFF switch.

3. Immerse meter to the level indicated in figure 1, approximately 1½ inches into the solution.

CAUTION: DO NOT IMMERSE ABOVE DISPLAY LEVEL

4. Stir gently and wait a few seconds for reading to stabilize.

5. Rinse the tip of the electrode in distilled or deionized water, blot dry and measure your next sample.

6. When not in use, turn switch "OFF" and replace the protective cap.

To improve meter performance, immerse the probe in tap water for a few minutes at least once a week.

CALIBRATION (refer to figure 2)

To calibrate the PS-15, immerse the probe in a known solution and adjust the reading using the trimmer located next to the pocket clip on the back of the unit.

BATTERY REPLACEMENT (refer to figure 2)

To change the batteries, carefully pull out the battery case and replace batteries.

PORTABLE SENSORS AVAILABLE FROM CORNING

PS-15 pH METER (Catalog Number 475810)

PS-16 THERMOMETER with "L" probe (Catalog Number 475811)

PS-17 CONDUCTIVITY METER (Catalog Number 475812)

PS-18 TDS METER (Catalog Number 475813)

PS-19 ORP METER (Catalog Number 475814)

CORNING TECHNICAL INFORMATION

1-800-222-7740

From NY or Canada: 1-607-974-4001

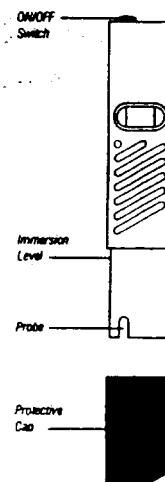


figure 1

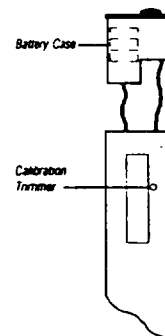


figure 2

MADE IN
MAURITIUS

IC-PS-15

pH Calibration & Measurement

General Calibration Procedure

For detailed calibration and temperature compensation procedures, consult your meter instruction manual.

Single-Buffer Calibration

1. Set up meter according to meter instruction manual.
2. Rinse electrode first with distilled water and then with the buffer being used for calibration (the buffer should be near the expected sample pH). Place the electrode in the buffer.
3. Wait for a stable display. Set the meter to the pH value of the buffer at its measured temperature. (A table of pH values at various temperatures is supplied on the buffer bottle.) See Table 1. Proceed to pH Measurement.

Two-Buffer Calibration

This procedure is recommended for precise measurements.

1. Select two buffers which bracket the expected sample pH. The first should be near the electrode isopotential point (pH 7) and the second near the expected sample pH (e.g., pH 4 or pH 10).
2. Rinse electrodes first with distilled water and then with pH 7 buffer. Place the electrode in pH 7 buffer.
3. Wait for stable display. Set the meter to the pH value of the buffer at its measured temperature. (A table of pH values at various temperatures is supplied on the buffer bottle.) See Table 1.

4. Rinse electrode first with distilled water and then with the second buffer. Place the electrode in the second buffer.
5. When display is stable, set meter to the actual pH value of the buffer as described in the meter instruction manual.
6. If all steps are performed correctly, and slope is between 92 and 102%, proceed to pH Measurement. If any of the above procedures does not work, refer to TROUBLESHOOTING.

Table 1
pH Values of NIST Buffers at Various Temperatures*

Nominal Value
at 25°C Temperature

	0°C	5°C	10°C	20°C	30°C
1.68	1.67	1.67	1.67	1.67	1.68
3.78	3.86	3.84	3.82	3.79	3.77
4.01	4.00	4.00	4.00	4.00	4.02
6.86	6.98	6.95	6.92	6.87	6.85
7.00	7.11	7.08	7.06	7.01	6.98
7.41	7.53	7.50	7.47	7.43	7.40
9.18	9.46	9.40	9.33	9.23	9.14
10.01	10.32	10.25	10.18	10.06	9.97

40°C	50°C	60°C	70°C	80°C	90°C
1.67	1.71	1.72	1.74	1.77	1.79
3.75	3.75				
4.03	4.06	4.08	4.13	4.16	4.21
6.84	6.83	6.84	6.85	6.86	6.88
6.97	6.97				
7.38	7.37				
9.07	9.01	8.96	8.92	8.89	8.85
9.89	9.83				

*NIST (National Institute of Standards and Technology) was formerly known as NBS.

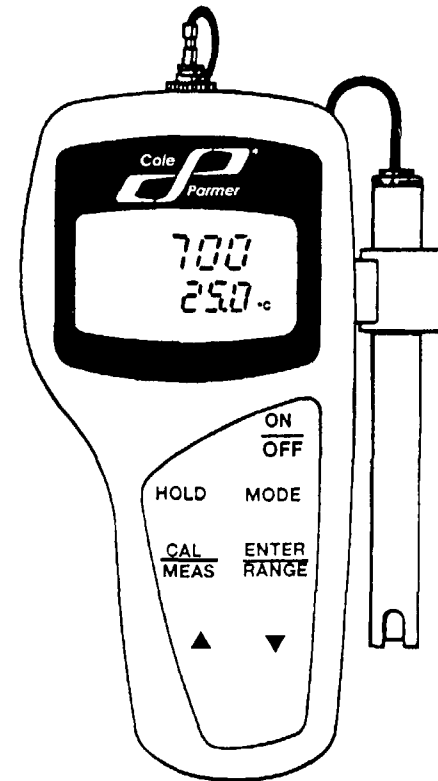
pH Measurement

1. Calibrate the electrode as described in previous section.
2. Rinse the electrode with distilled water and then with sample.
3. Place the electrode in the sample.
4. When the display is stable, record sample pH.

SPECIFIC CONDUCTANCE MEASUREMENTS

Operating Instructions

Cole-Parmer® 19815-00 Basic Conductivity Meter



Printed in the U.S.A. 1194-R1

Cole-Parmer Instrument Company

625 E. Bunker Court, Vernon Hills, Illinois 60061-1844
1-847-549-7600 or Toll-free 1-800-323-4340
Fax: 1-847-549-7676 Telex: 28-9405

of the holder.

2. Insert the probe into the hole of the holder until the top housing of the probe touches the top of the holder.

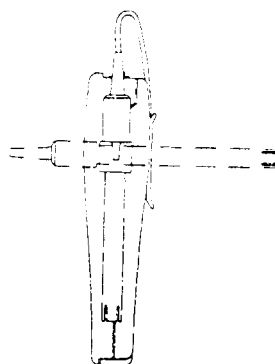
Attaching the electrode holder to the meter

1. Place the probe holder with the flange facing the slot on the meter. See Figure 5, right.
2. Gently slide the holder flange in the slot. Make sure holder is fixed properly into slot. You can attach the probe holder in different positions, as shown in Figure 6, right. This flexibility helps one-hand operation.

Figure 5



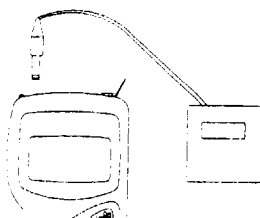
Figure 6



Connecting the optional AC adapter

1. Insert the AC jack as shown in Figure 7, below. This helps conserve batteries but is not required for operation.
2. **Switch off the meter before plugging the adapter into the power source.** This safety precaution protects the memory in your meter.
3. Press the ON/OFF button to switch the power ON.

Figure 7



4. Calibration

Select a conductivity standard near the sample value you are measuring.

The next best method is to choose a calibration solution value that is approximately 2/3 the full scale (F.S.) value of the measurement range. For example in the 0 to 1999 μS range, use a 1413 μS solution for calibration. See "Specifications", page 10.

Preparing the Meter for Calibration

1. Press the ON/OFF key.

All the LCD segments display for a few seconds. The LCD switches to the conductivity measurement mode.

2. Press the MODE key to select your mode. Select one of the two calibration modes: COND (conductivity) or TEMP (temperature).

You only need **one** calibration for measurement of the entire range of the

meter. If a range was not calibrated, the meter automatically detects the closest range calibrated and uses the calibration information. However, only the ranges that have been calibrated have maximum accuracy.

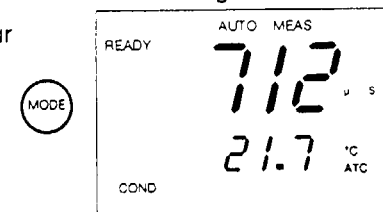
If you are measuring in ranges greater than 20 mS or conductivity lower than 100 μS , **calibrate** the meter at least once a week to get specified $\pm 1\%$ F.S. accuracy. If you are measuring in the mid ranges, and you washed the probe in deionized water and stored it dry, calibrate the meter once a month. Wet the probe for 10 minutes before calibrating or taking readings to saturate the probe surface and minimize drift. If you make measurements at extreme temperatures, calibrate at least once a week.

Use only the conductivity probe specified for these meters. If you do not, you must measure the solution temperature separately and manually enter the solution temperature.

Calibrating for Conductivity

1. Pour out 2 separate portions of your calibration standard and one of deionized water into separate clean containers.
2. Press MODE and select COND. See Figure 8, right.

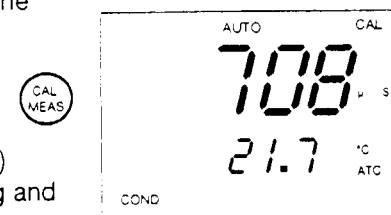
Figure 8



3. Rinse your electrode with deionized water then rinse in one of the portions of calibration standard.
4. Immerse the electrode into the other standard solution, and press CAL.

NOTE: Allow at least 5 minutes for the probes to equilibrate at the solution temperature. The display shows the CAL mode. "CAL" blinks on the display as long as the calibration mode is on. The primary (larger) display shows the measured reading and the secondary display shows the temperature. See Figure 9, right.

Figure 9



5. Enter value of your conductivity standard. The meter automatically compensates for temperature differences. Use the \blacktriangle or \blacktriangledown to scroll to your chosen standard value.

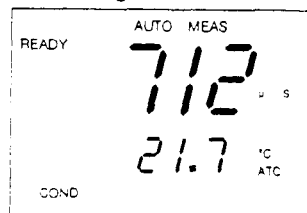
6. Confirm calibration by pressing ENTER/RANGE button.

Upon confirmation, the CAL indicator stops flashing and remains on the screen for 3 seconds. The meter switches back into the measurement mode and the calibrated and temperature compensated value will be

3. Dip the electrode into the sample.

NOTE: When dipping the electrode into the sample, make sure the tip of the probe is completely immersed into the sample. Stir the electrode gently in the sample to create a homogenous sample. Make sure there are no air bubbles trapped in the slot of the probe. To remove air bubbles, give the probe a gentle shake making sure the electrode tip is submerged.

Figure 17



4. Take readings.

When the reading is stable, a READY annunciator displays. See Figure 17, left.

NOTE: For ATC measurements, attach the temperature sensor connector to the conductivity meter. The ATC annunciator lights up. Insert the probe into the solution to be measured so the sample temperature

can be recorded and compensated. Allow a few minutes for the temperature reading to come to equilibrate with the solution.

Hold

1. Press HOLD to freeze a measurement.

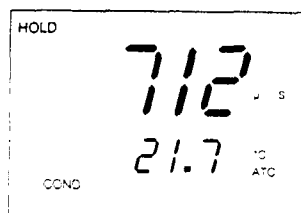
When HOLD mode is activated, the HOLD mode annunciator displays.

See Figure 18, right.

Release a held value

1. Press HOLD again and get "live" readings. The Hold annunciator disappears from the LCD.

Figure 18



Temperature Normalization and Temperature Coefficient

The conductivity of solution varies greatly with temperature. The automatic temperature compensation (ATC) of the conductivity meters adjusts conductivity measurements to eliminate the conductivity changes caused by temperature. Readings are usually referenced to or normalized at a standard temperature (25°C), and ATC gives the corrected readout of the equivalent conductivity solution normalized to 25°C.

7. Probe Care and Maintenance

Keep the conductivity probe clean. Rinse the probe twice, and gently swirl it while you take readings. For the best accuracy, soak a dry probe for at least 5 to 10 minutes or longer before calibration. Wash the probe with deionized or tap water before storing it. Never scratch the platinum portions with a hard substance. Do not strike the probe against any hard surface.

Do not make continuous contact with your solutions. Readings rise over a continuous period of time if you soak your probe.

Do not immerse the probe in oily solutions. Clean the electrode thoroughly by immersing it in an agitated mild detergent bath. Wipe the probe with a soft tissue paper. Wash thoroughly in tap water and then in deionized water. Recalibrate the meter after cleaning it.

8. Error Messages

LCD Display	Indicates	Cause	Solution
Err. 1 (in primary display)	Memory write error	Instrument too old (>10 years). Hardware failure	Return*
Err. 2 (in primary display)	Memory checksum error	Batteries too weak. Hardware failure.	Press ENTER, then turn off meter. Change batteries. Recalibrate Return*
Err annunciator	Unrecognized input from keypad	Wrong input in selected mode.	Release key. Select valid operations depending on mode.
CAL & Err annunciators blink	Calibration error	Wrong value input at calibration. Dirty probe	Check value, clean probe. See "Probe Care and Maintenance" above.
Err. 3	ADC error	Faulty hardware	Return*
Err. 4	Keypad stuck error	Faulty hardware	Return*

You will see the errors in the primary display (the row of larger digits). To eliminate the errors, switch off the meter and switch it ON again. All keys become inactive. If error persists, or the meter shows incorrect values, return the meter.

* See "Warranty" and "Return of Items"

12. Warranty

The Cole-Parmer Instrument Company warrants this product to be free from significant deviations in material and workmanship for a period of one year from date of purchase. If repair or adjustment is necessary and has not been the result of abuse or misuse within the one year period, please return—freight prepaid—and correction will be made without charge. Cole-Parmer alone will determine if the product problem is due to deviations or customer misuse.

Out-of-warranty products will be repaired on a charge basis.

13. Return of Items

Authorization must be obtained from our Customer Satisfaction Department before returning items for any reason. When applying for authorization, please include data regarding the reason the items are to be returned.

For your protection, items must be carefully packed to prevent damage in shipment and insured against possible damage or loss. Cole-Parmer will not be responsible for damage resulting from careless or insufficient packing. A restocking charge will be made on all unauthorized returns.

NOTE: The Cole-Parmer Instrument Company reserves the right to make improvements in design, construction and appearance of our products without notice.

Cole-Parmer - Reg TM Cole-Parmer Instrument Co.



806-00

Cole-Parmer Instrument Company

625 E. Bunker Court, Vernon Hills, Illinois 60061-1844

1-847-549-7600 or Toll-free 1-800-323-4340

Fax: 1-847-549-7676 Telex: 28-9405

TURBIDITY MEASUREMENTS

VII. CALIBRATION PROCEDURES

A. STANDARD FORMAZIN SOLUTIONS

Calibration of this instrument is based on Formazin, a material which can be made by synthesis and reproduced repeatedly within one percent. When properly mixed, it is uniform in the number, size and shape of its particles, thus making it an ideal turbidity standard. The unit of measure, and thus the calibration of this instrument is in Nephelometric Turbidity Units (NTU) based on Formazin.

Calibration samples may be obtained by diluting Formazin stock suspension using "Turbidity-Free" water. Formazin stock suspension may be prepared by the user (Reference A.W.W.A. "Standard Methods", 14th Edition) or it may be purchased in kit form, HF scientific part number 50040.

Each kit contains:

- 1 liter of 4000 NTU Stock Suspension
- 1 Gallon (3.79 liters) turbidity-free water
- 7 Sample cuvettes (28mm), with screw caps
- Instructions for dilution
- 1 200 μ l Pipette

The following table gives the recommended dilutions of the stock suspension. Be sure to adequately mix the stock suspension prior to removing a portion for dilution.

PROCEDURE

Value	Pipettes required	Pipette into a 200ml volumetric flask
198 NTU	10ml graduated in tenths of a ml	9.9ml of 4000 NTU stock. Add low turbidity water to 200 ml mark.
19.8 NTU	20ml volumetric	Pipette 20ml of the 198 dilution above into another 200ml volumetric flask. Add low turbidity water to the 200ml mark.
2.0 NTU	2.0ml volumetric	Pipette 2.0ml of the 198 dilution into a 200ml volumetric flask. Add low turbidity water to the 200ml mark. NOTE: Value includes 0.02 NTU added by the water.

NOTE: 1. When the prepared samples start to flocculate, they are unreliable and fresh ones must be made. This will occur more rapidly for the lower value diluted suspensions.

B. ELECTRONIC CALIBRATION USING FRESHLY PREPARED FORMAZIN SOLUTIONS

The DRT Turbidimeters have been carefully calibrated by the factory. However, should the Electronic P.C. Board, the Photo Detectors, or the Light Source be replaced or if very carefully prepared Formazin suspensions indicate a need for recalibration, this may be easily accomplished in your facility.

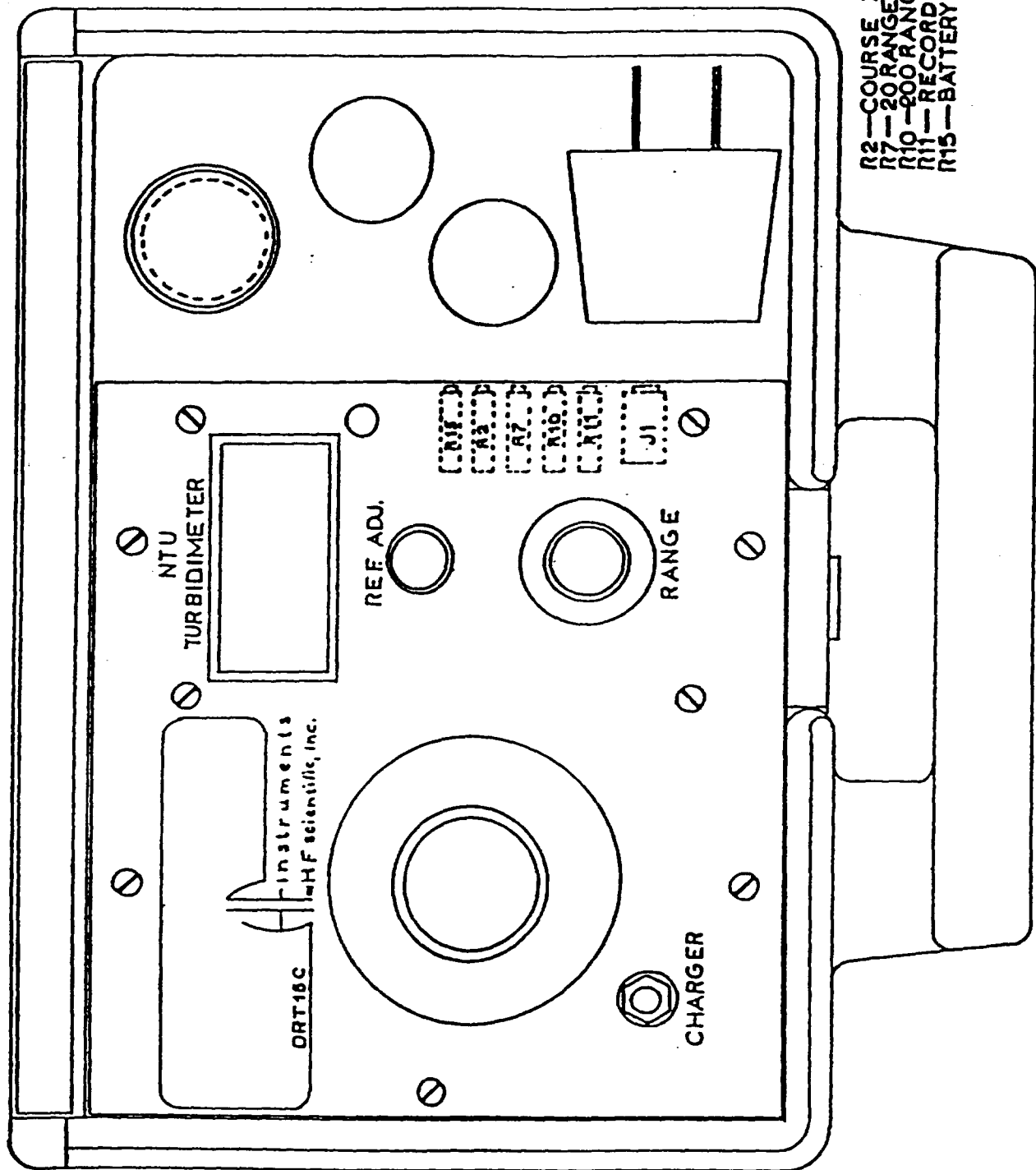
To carry out a complete calibration the following Formazin suspension values are required:

- | | | |
|-----------|---|------------------------------------|
| 198 NTU, | - | Fill, cap and label a separate |
| 19.8 NTU | | cuvette with a sample of each. |
| & 2.0 NTU | - | |
| | - | Always mix the contents of each |
| | | cuvette by inverting several times |
| | | before placing in the Optical Well |
| | | for a reading. |
| | - | Keep the outside surface of |
| | | cuvettes clean. |
| | - | When placing any standards in the |
| | | well, always use the Light Shield |
| | | to cover the well in order to keep |
| | | out ambient light. |

To gain access to the trimpots, remove the accessories from the foam holder. Refer to figure 2 for trimpot identification during the next few steps.

- 1) Center the reference adjust control on top of the instrument.
- 2) Insert the reference standard and turn the range control on the DRT-15C to the 20 range. Adjust the "Course Zero" trimpot (R2) until a reading of 0.02 NTU is obtained.
- 3) Replace the reference standard with the 19.8 formazin standard and adjust the "20 Range Adjust" trimpot (R7) to obtain a reading of 19.8 NTU \pm 0.1 NTU.
- 4) Replace the 19.8 NTU formazin standard with the reference standard and adjust the reference adjust control to obtain a reading of 0.02 NTU.
- 5) Repeat steps 3 and 4 until no further adjustments are required.
- 6) The 2.0 NTU Formazin Standard may be used to check calibration for low readings.
- 7) Turn the range control on the DRT-15C to the 200 range. Insert the 198 NTU formazin standard and adjust the "200 Range Adjust" trimpot to obtain a reading of 198 \pm 1 NTU.

This completes the calibration of the DRT-15C.



How It Works

1. Place the supplied HF factory certified secondary reference standard in the optical well and set reference adjustment knob to read 0.02 NTU.
2. Next, place one of the three supplied HF certified alternative primary standards in the optical well and adjust the low calibration control to read the certified primary value of 0.50 NTU.
3. Affix the certification seal to your HF turbidimeter with date calibrated and signature.
4. Now just repeat every four months.

Ordering Information

Calibration Kit	Catalog Number	Price
DRT-15B, DRT 100B (portable laboratory)	19885	\$149/kit
DRT-200, Micro-T	19886	\$149/kit

For other models contact our factory

Kit Advantages

Regulatory Compliance

Approved by EPA, standard method ASTM AEPA-1 (method 180.1 Federal Register Nephelometric Standard Method (Volume 16), ASTM (D1889-88a).

Economy

Full one year supply for one low price. Safe for your personnel; harmless to our environment.

Convenience

Eliminates formulation and preparation time and error; never needs mixing.

Stability

Does not deteriorate; will not settle out; long shelf life.

Accuracy

Guaranteed reproducible to $\pm 1\%$.

Description

Each kit comes with:

- Deluxe polyethylene foam carrying case
- 1 ea. sealed reference standard
- 1 ea. special index light shield
- 3 ea. 28mm cuvettes 0.5 NTU certified alternative primary calibrating standards
- 3 ea. selected measuring cuvettes
- 3 ea. certification stickers
- 1 ea. factory registration card
- 1 ea. instruction manual

Local Representative:



3052 Metro Parkway S.E., Fort Myers, FL 33916-7539
Phone: (813) 337-2116 FAX: (813) 332-7643

PHOTOIONIZATION DETECTOR

Chapter 2 Operation

Play 100 ppm
010>10:20 Feb 15

Play 100 ppm
012<10:22 Feb 15



measuring and recording real time concentrations even though the instrument status is "Play". If, during playback, an instrument status with a priority higher than that of "Play" is encountered in real time operation it will be displayed, but MicroTIP will continue to play back.

Playback speed can be increased or decreased by pressing the arrow keys. Information can also be viewed in the opposite direction, again, by pressing the arrow keys. A forward arrow (>) appears in the display if data are being played forward or a backward arrow (<) if the data are being played in reverse.

Press ENTER to freeze the display at any time and use the arrow keys to resume playback. Press EXIT to return to the normal display.

The PLAY function provides a speed search to find the desired start and stop Event numbers for printing or graphing.

2.14 CAL

MicroTIP must be calibrated in order to display concentration in units equivalent to ppm. First a supply of zero air, which contains no ionizable gases or vapors, is used to set MicroTIP's zero point. Then, span gas, containing a known concentration of a photoionizable gas or vapor, is used to set the sensitivity.

Usually clean ambient air will be suitable as zero air. If there is any doubt, use a commercial source of zero grade air and a second sampling bag. Span gas of the desired compound and concentration, required for calibration, may be obtained from a specialty gas supplier. See Appendix B.

Isobutylene at 100 ppm in air is recommended as span gas. To calibrate the instrument use the Calibration Kit (Photovac Part No. 390033) as follows:

1. Connect the supplied regulator to the span gas cylinder. Hand tighten the fittings. Observe proper handling techniques for all gases.

Chapter 2 Operation

Cal memory ? ↑↓
7

Response factor?
1.00

Connect zero gas
then press ENTER

Calibrating now,
please wait...

Span conc ? ppm
100.00

Connect span gas
then press ENTER

Calibrating now,
please wait...

2. Open the valve on the gas bag by turning the valve stem fully counterclockwise.
3. Attach the nut to the regulator. Hand tighten the fittings.
4. Turn the regulator knob counterclockwise about half a turn to start the flow of gas.
5. Fill the gas bag about half full and then close the regulator fully clockwise to turn off the flow of gas.
6. Disconnect the bag from the adapter and empty it. Flush the bag a few times with the span gas and then fill it.
7. Close the gas bag by turning the valve clockwise.
8. Press SETUP and select the desired Cal Memory with the arrow keys and press ENTER. Press EXIT to leave Setup.
9. Press CAL and enter the desired response factor. Use Table 2, on page 21, to find the correct response factor for the compound of interest. If the compound is not in Table 2 or you are not looking specifically for one compound then enter 1.00.

The concentration detected by MicroTIP will be multiplied by the response factor before it is displayed and logged.
10. Expose MicroTIP to zero air. Press ENTER and MicroTIP sets its zero point.
11. MicroTIP then asks for the span gas concentration. Enter the known span gas concentration and then connect the span gas bag adapter to the inlet.
12. Press ENTER and MicroTIP sets its sensitivity.
13. When MicroTIP's display reverts to normal, MicroTIP is calibrated and ready for use. Remove the span gas bag from the inlet.

Chapter 2 Operation



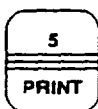
MicroTIP has 10 Cal Memories and can be calibrated with 10 different span gases or response factors if desired. Only one Cal Memory can be used at a time. Each memory stores a different response factor, zero point and sensitivity. To program the Cal Memories:

1. Press SETUP and select the desired Cal Memory (1 to 10) with the arrow keys.
2. Exit from SETUP and press the CAL key.
3. Enter the desired response factor and press ENTER.

Note: It does not matter which Cal Memory is selected or which response factor is entered, MicroTIP's response is not specific to any one compound. The reading displayed represents the total concentration of all photoionizable compounds in the sample.

4. Follow the displayed calibration instructions. When the calibration is completed it is automatically stored in the selected Cal Memory. The span gas concentration entered here is specific to the selected Cal Memory.

Whenever the instrument is calibrated, MicroTIP updates the selected Cal Memory only. The instrument should be calibrated at least once a day.



2.15 PRINT

MicroTIP was designed to be used with an Epson® FX-80 or 100% compatible printer with an RS232 serial interface. If an Epson FX-80 compatible printer is to be used, the printer cable and suitable adapter (Photovac Part No. 395006) should work.

The printer must be set to 8 data bits and 1 stop bit to communicate with MicroTIP. MicroTIP's baud rate and parity must be set depending on the printer requirements. Refer to the printer user's manual for more information.

MicroTIP is not UL-classified for use in hazardous locations with printers.

FLAME IONIZATION DETECTOR

CALIBRATION

Primary Calibration for Methane

Internal electronic adjustments are provided to calibrate and align circuits. After initial factory calibration, it should not be necessary to repeat calibration unless analyzer undergoes repairs which affect calibration. If OVA 128 will be used extensively for analysis of a sample other than methane, recalibration of the electronics (after resetting the GAS SELECT dial) may result in better accuracy. See Recalibration to Various Organic Vapors above.

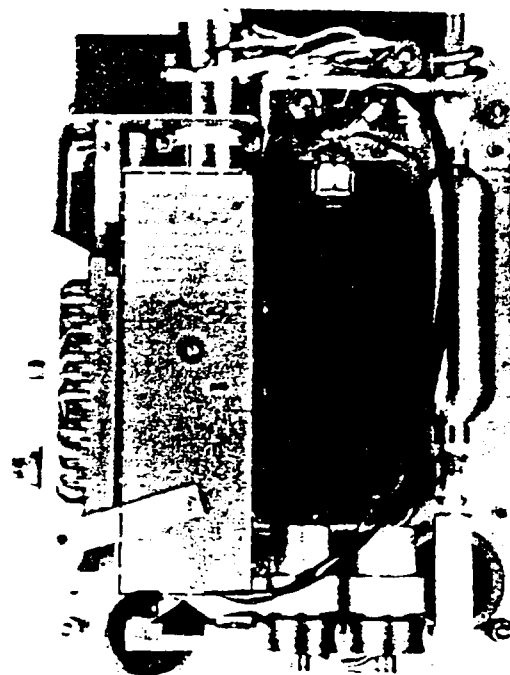
Primary calibration of this instrument is accomplished at the factory using methane-in-air sample gases. Methane-in-air calibration kits are available from Foxboro.

For more accuracy on the X100 scale, a 950 to 980 ppm sample of methane should be introduced. Fine tune R33 on printed wiring board assembly (see Figure 4).

Calibration Using Known Samples for Each Range (Refer to Figure 4)

The accuracy stated under Specifications is obtained when the instrument is calibrated with known concentrations for each range. Prepare separate samples of Methane-in-air in these concentration ranges: 7 to 10 ppm, 90 to 100 ppm, and 900 to 1000 ppm. Calibrate the instrument as follows:

1. Place the instrument in normal operation and allow a minimum of 20 minutes for warm-up and stabilization; then zero out the ambient air.
2. Set the GAS SELECT dial to 300.
3. Set the CALIBRATE Switch to X10.
4. Set the CALIBRATE ADJUST (Zero) knob so that the meter reads zero.
5. Check that the meter reads zero on the X100 and X1 ranges.
6. Set the CALIBRATE Switch to X1 and introduce the sample with known concentration in the 7 to 10 ppm range.
7. Adjust R31 so that the meter reading corresponds to the sample concentration.
8. Set the CALIBRATE Switch to X10 and introduce the sample with known concentration in the 90 to 100 ppm range.
9. Adjust R32 so that the meter reading corresponds to the sample concentration.
10. Set the CALIBRATE Switch to X100 and introduce the sample with known concentration in the 900 to 1000 ppm range.



R-31 R-32 R-33 R-38

Figure 4.
Location of Electronic Trimpot Adjustments

11. Adjust R33 so that the meter reading corresponds to the sample concentration.
12. The instrument is now calibrated for methane and ready for use.

Calibration Using a Single Sample Calibration (Refer to Figure 4,

Calibration may be accomplished using a single known sample of methane in air in the range of 90 to 100 ppm. This may not provide the accuracy stated under specifications but is adequate for field survey work.

1. Place instrument in normal operation with CALIBRATE Switch set to X10 and GAS SELECT dial set to 300, and allow 20 minutes for warm up and stabilization.
2. Use the CALIBRATE ADJUST (zero) knob to adjust the meter reading to zero.
3. Introduce a methane sample of a known concentration (between 90 and 100 ppm, not to exceed 100 ppm) and adjust trimpot R32 so the meter reading corresponds to the known sample.
4. Extinguish the flame by blocking the exhaust ports.
5. Leave CALIBRATE Switch on X10 position and use CALIBRATE ADJUST (zero) knob to adjust Readout meter reading to 4 ppm.

6. Move the CALIBRATE Switch to the X1 position and using trimpot R31, adjust Readout meter reading to 4 ppm.
7. Move CALIBRATE Switch to X10 position again. Use CALIBRATE ADJUST (zero) knob to adjust Readout meter to 40 ppm.
8. Move CALIBRATE Switch to X100 position and use trimpot R33 to adjust Readout meter to 40 ppm.
9. Move CALIBRATE Switch back to X10 scale. Zero Readout meter to 0 ppm; reignite instrument.
10. Unit is now balanced over the full range, calibrated to methane, and ready to be placed in normal service.

Recalibration to Various Organic Vapors

NOTE

In order to reduce error, test sample must be prepared in the same background air as was present when the instrument was "zeroed".

The OVA 128 is capable of responding to nearly all organic compounds. At the time of manufacture, the analyzer is calibrated to mixtures of methane in air. For precise analysis it is necessary to recalibrate with the specific compound of interest. The GAS SELECT dial is used to set the electronic gain for a particular compound.

The instrument is recalibrated using a known concentration of a specific vapor in air. After the instrument is in operation and the normal background is zeroed, draw a sample of the calibration gas into the instrument. The GAS SELECT dial on the panel is then used to set the readout meter indication to correspond to the concentration of the calibration gas mixture.

The instrument has now been calibrated to the vapor mixture being used. After this adjustment, the setting on the GAS SELECT dial, and instrument serial number should be recorded for that particular organic vapor compound. This exercise can be performed for a large variety of compounds, thereby generating a "library" which can be used for future reference without need for additional calibration standards.

NOTE

Direct readout to the selected compound is valid only within the range in which the response is linear, and for the specific instrument for which calibration was performed.

To read a particular compound, the GAS SELECT dial is turned to the predetermined setting for the compound. Calibration on any one range automatically calibrates the other two ranges.

Using Empirical Data

Relative response data can be used to estimate the concentration of a vapor without need to recalibrate the analyzer. With the instrument calibrated to methane, obtain the concentration reading for a calibration sample of the test vapor. The relative response (R) in percent for that vapor is:

$$R(\text{in } \%) = \frac{\text{Measured Concentration}}{\text{Actual Concentration}} \times 100$$

NOTE

The actual concentration can be determined by merely dividing the measured concentration by the relative response (expressed as a decimal).

The EPA quantifies detector sensitivity by utilizing a "Response Factor" for each compound, rather than a relative response in %.

where:

$$\text{Response Factor} = \frac{\text{Actual Concentration}}{\text{Measured Concentration}}$$

To determine the concentration of an unknown sample of that vapor, multiply the measured concentration by the Response Factor.

Calibration Standards

Commercial Standards

Commercially available standard samples offer the most convenience and are recommended for the most precise analyses. Always remember to obtain the desired vapor in an ambient air background. Samples should be drawn from the cylinder into a collapsed sample bag, then drawn from the bag by the instrument to prevent a pressure or vacuum at the sample inlet.

**Standard Operating Procedure
for
Soil Sampling**

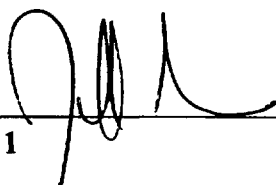
SOP ID: 10006

Date Initiated: 2/20/90

Revision #004: 6/19/97

Approved By:

Name 1



6-19-97

Date

Name 2

Gail S. Batchelder

6/19/97

Date

LOUREIRO ENGINEERING ASSOCIATES

Standard Operating Procedure for Soil Sampling

1. Statement of Purpose

This document discusses procedures for collection of soil samples for analytical analysis. Methods for collection and quality assurance/quality control requirements are covered under separate SOPs. The procedures outlined in this document are in accordance with ASTM Standard D 420 and the EPA document Test Methods for Evaluating Solid Waste, Physical/Chemical Methods (SW-846). These procedures may vary slightly according to the needs of specific projects.

2. Equipment and Equipment Documentation

2.1. Equipment required for the collection of soil samples shall include:

- Stainless steel spatula
- Distilled water
- Hand towels
- Polyethylene plastic sheeting
- Sample collection jars
- Clean disposable gloves
- Field documentation
- Indelible marker
- Cooler, cold packs and maximum/minimum thermometer
- Custody seals and sample labels
- Polythethylene plastic sheeting (5-mil thickness)

2.2 Cleaning and Decontamination

2.2.1 Prior to collecting a soil sample, the LEA representative will ensure that all necessary sampling equipment is clean and decontaminated according to the site-specific work plan or collection method SOPs.

2.2.2 Upon completion of all sampling requirements and prior to leaving the site, all equipment used for sampling shall be cleaned and decontaminated. All generated decontamination fluids shall be disposed of in accordance with the site-specific work plan and all municipal, state, and federal requirements.

3.0 Sampling Protocols

3.1 Preliminary Sampling Procedures

3.1.1 Sample Bottles

3.1.1.1 A Laboratory Request Form shall be completed and submitted to the laboratory with following information:

- Project name
- LEA commission number
- Date of submittal and date needed
- Quantity of sample locations and sample points at each location
- Type(s) of samples
- Analytes, detection limits and QA/QC needed
- Cooler(s) required
- Number of Chain-of-Custody forms requested

3.1.1.2 Check bottles against Laboratory Request Form for completeness. The bottles should also be checked for damage and cleanliness. Confirm with laboratory personnel the adequacy of the preservatives used.

3.1.1.3 Label all bottles prior to sampling with the information and check for accuracy. This step may also be performed in the field prior to sample collection.

3.1.1.4 The total number of sample sets shall be increased by 10% to allow for possible breakage during transport to sites or other contingencies (minimum: one additional sample bottle set per event).

3.1.1.5 A cooler with adequate ice or cold packs should be obtained from the laboratory to insure that the collected samples remain at 4°C during transport. Packing material should also be obtained to insure against breakage during transport.

3.1.2 Site Preparation

3.1.2.1 A level table shall be placed within the exclusion zone and covered with polyethylene sheeting.

- 3.1.2.2 Decontaminated spatulas shall be placed on the table. Prelabeled sample bottles shall be placed in a convenient location and in order of sample collection.

3.2 Sampling Procedures

- 3.2.1 All personal protective equipment (PPE) should be donned and maintained in accordance with the site-specific work plan or health and safety plan during all sampling procedures. In the event that no PPE has been specified for a particular sampling event, disposable latex gloves should be donned, as a minimum, during all sampling procedures.
- 3.2.2 The particular soil sampling device (i.e. hand auger, split spoon, etc.) shall be retrieved from the point of collection and placed on a level table covered in polyethylene sheeting.
- 3.2.3 Using a decontaminated stainless steel spatula, the soil shall be transferred directly into prelabeled soil sampling containers. Care should be taken to completely fill the sample container intended for VOC analysis. Large void spaces within the container shall be minimized by packing, not agitation.
- 3.2.4 Wipe the rim of the sample container with a clean paper towel to remove excess solids which would prevent adequate sealing of the sample container and seal the container.

The order of sample collection shall be as follows:

- samples to be analyzed for volatile organic compounds at the LEA Analytical Laboratory
 - samples to be analyzed for volatile organic compounds using appropriate EPA methodologies
 - samples to be screened for total volatile organic compounds with a total volatile organic analyzer
 - samples to be analyzed for other organic and inorganic constituents
- 3.2.5 As required, affix a custody seal, noting the date and time of collection across the cap/bottle interface and on the sample label. Place and secure sample within cooler and complete all sample collection documentation.

3.3 Post-Sampling Procedures

- 3.3.1 As required, upon completion of all sampling procedures for a particular site, secure the lid of the cooler using packaging tape with the Chain-Of-Custody inside.
- 3.3.2 Should the laboratory be local, transport the samples directly to the laboratory and present them to the sample manager. The representative of LEA should witness the verification of the Chain-Of-Custody and obtain a carbon copy for filing in the project notebook.
- 3.3.3 Should the laboratory be distant, arrange for transport with a reputable carrier service. The cooler and samples shall be secured for transport, and all mailing documentation secured onto the top of the cooler. Unless otherwise specified, delivery shall be overnight. A request for confirmation of acceptance should be made to the carrier at the time of pick-up.

3.4 Documentation

- 3.4.1 The following general information shall be recorded in the field log book and/or on the appropriate field forms:
- Project and site identification
 - LEA commission number
 - Field personnel
 - Name of recorder
 - Identification of borings
 - Collection method
 - Date and time of collection.
 - Types of sample containers used, sample identification numbers and QA/QC sample identification
 - Preservative(s) used
 - Parameters requested for analysis
 - Field analysis method(s)
 - Field observations on sampling event
 - Name of collector
 - Climatic conditions, including air temperature
 - Internal temperature of field and shipping (refrigerated) containers
 - Chronological events of the day
 - Status of total production
 - Record of non-productive time
 - QA/QC data

3.4.2 The following information shall be recorded on the Field Quality Review Checklist:

- Reviewer's name, date, and LEA commission number
- Review of all necessary site activities and field forms
- Statement of corrective actions for deficiencies

3.4.3 The following information shall be recorded on the chain-of-custody record:

- Client's name and location
- Boring or sampling location identification
- Date and time of collection
- Sample number
- Container type, number, size
- Preservative used
- Signature of collector
- Signatures of persons involved in the chain of possession
- Analyses to be performed
- Type and number of samples

3.4.4 The following information shall be provided on the sample label using an indelible pen:

- Sample identification number
- Date and time of collection
- Place of collection
- Parameter(s) requested (if space permits)

3.4.5 The following information shall be recorded on the sample collection data sheet:

- Client name, location and LEA commission number
- Boring or sampling location identification number
- Date and time of collection
- Sample number
- Depth sample was obtained
- Field instrumentation reading

**Standard Operating Procedure
for
Air Sample Collection
For Remediation Systems Monitoring**

SOP ID: 10013

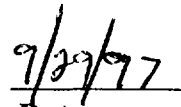
Date Initiated: 9/1/92

Revision #002: 7/7/95

Approved By:



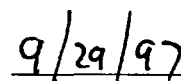
Name 1



Date



Name 2



Date

LOUREIRO ENGINEERING ASSOCIATES

Standard Operating Procedure for Air Sample Collection For Remediation Systems Monitoring

1. Statement of Purpose

This Standard Operating Procedure (SOP) describes procedures to be followed for collecting air samples from vapor probes, vapor extraction wells, soil vapor extraction blowers and activated carbon drum discharges during monitoring of remediation systems such as soil vapor extraction or bioventing.

2. Equipment

- Air sampling equipment (including air flowmeter and pump)
- Vacuum desiccator
- Tedlar® bags
- Tygon® tubing (3/16" ID x 3/8" OD and 1/4" ID x 3/8" OD)
- Portable VOC analyzer (Photovac Microtip, Foxboro OVA)
- Field report blanks
- Labels
- Batteries
- Knife
- Adjustable wrench
- Channel-lock pliers
- Screw drivers (Phillips Head)
- Miscellaneous adapters and fittings

3. Sample Collection

3.1. Vapor probe sampling

The procedures described below apply to all vapor probe sampling performed, with the exception of obtaining highly contaminated vapor samples (in the order of 10 ppm or greater) in which significant residual cross contamination is suspected (Section 3.2).

- 3.1.1. Comply with all site-specific health and safety requirements. Always wear appropriate personal protective equipment and check local air quality using a portable VOC analyzer to ensure a safe working environment.
- 3.1.2. Remove protector cap from the vapor probe.
- 3.1.3. Open vapor probe valve. Take a reading with the portable VOC analyzer and record this value in the field report.
- 3.1.4. Close vapor probe valve.
- 3.1.5. Place 3/16" ID x 3/8" OD Tygon® tubing on the brass vapor probe adaptor, 6" length. Screw vapor probe adaptor onto vapor probe. Next attach the vapor probe tubing to the stainless steel adaptor tube of the air sampling equipment. Keep tube lengths as short as possible.
- 3.1.6. Double check air sampling equipment pump for damage. Repair if necessary. Check all fittings for leaks. If evidence of leakage appears, check all connections for tightness and tighten, accordingly. Once leakage problems are corrected, open vapor probe valve.
- 3.1.7. Attach clean length of 1/4" ID x 3/8" OD tube, approximately 4" long, from the air sampling equipment to the Tedlar® bag. Open Tedlar® bag valve by turning the Teflon® screw and pushing down on the stainless steel valve.
- 3.1.8. Purge system by filling and emptying the Tedlar® bag three times. Open cap to expel air. Do not fill bag to firmness at any time. This is done to prevent stress cracks from forming and destroying the Tedlar®.
- 3.1.9. Collect the sample by filling the Tedlar® bag being careful not to overfill. Close valve on bag and remove bag from system. Label bag and log in the field report.
- 3.1.10. Allow the air sampling equipment pump to run between samples for a minimum of 2 minutes. Change tubing between different sampling areas, following known high samples, or when sampling in areas with unknown concentration ranges. It is not necessary to change the tubing in areas with known low concentrations (less than 100 ppb) after each sample. In this case, tubing should be replaced after every 6 samples, after a blank sample is collected.

3.2. Highly contaminated vapor probe sampling.

These procedures will be followed when highly contaminated vapor samples (in the order of 10 ppm or greater) are suspected.

- 3.2.1. Use the vacuum desiccator to avoid contamination of the air sampling equipment and possible cross contamination of samples.
- 3.2.2. Comply with all site-specific health and safety requirements. Always wear appropriate personal protective equipment and check local air quality using a portable VOC analyzer to ensure a safe working environment.
- 3.2.3. Remove protector cap from the vapor probe.
- 3.2.4. Open vapor probe valve. Take a reading with the portable VOC analyzer and record this value in the field report.
- 3.2.5. Replace 3/16" ID x 3/8" OD Tygon® tubing on the brass vapor probe adaptor, (6" length). Screw vapor probe adaptor onto vapor probe. Next attach the vapor probe tubing to the vacuum desiccator. Keep tube lengths as short as possible.
- 3.2.6. Attach 1/4" ID x 3/8" OD Tygon® tubing to the Tedlar® bag and the other end to the inside of the vacuum desiccator. Place the Tedlar® bag into the vacuum desiccator. Attach a length of 1/4" ID x 3/8" OD tubing, approximately 4" long, from the vacuum desiccator to the air sampling equipment intake.
- 3.2.7. Turn on the air sampling equipment. The air sampling equipment should be set to pump at a maximum rate.
- 3.2.8. Purge system by filling and emptying the Tedlar® bag three times. Do not fill bag to firmness at any time. This is done to prevent stress cracks from forming and destroying the Tedlar® bag. Every time the bag is filled you must open the vacuum desiccator, remove the Tedlar® bag and then empty the bag. Afterward place the bag into the vacuum desiccator again and continue these steps until the system is purged.
- 3.2.9. Collect the sample by filling the Tedlar® bag being careful not to overfill. Close the valve on the Tedlar® bag and remove the bag from the desiccator. Label bag and log in the field report.

3.2.10. Discard Tygon® tubing between each sample point. When using the vacuum desiccator, it is not necessary to run the pump for two minutes between samples and the tubing between the pump and the desiccator does not need to be discarded between samples.

3.3. Sampling of vapor extraction wells, blower discharges and carbon drum discharges. The procedures described in this section apply to all vapor sampling with the exception of collecting highly contaminated vapor samples (in the order of 10 ppm or greater) where significant cross contamination is suspected (Section 3.4).

3.3.1. Check local air quality surrounding the sample collection point to ensure safe working conditions for field personnel.

3.3.2. Open sampling port. Next, take a reading with the portable VOC/analyzer and record this value in the field report.

3.3.3. Close the sampling port.

3.3.4. Attach the air sampling equipment to the sampling port with 3/16" ID x 3/8" OD Tygon® tubing. Use the shortest length feasible.

3.3.5. Turn on the air sampling equipment pump. Check for leaks as in 3.1.6. Once leakage problems are corrected, open sampling port.

3.3.6. Attach clean length of 1/4" ID x 3/8" OD tube, approximately 4" long, from the air sampling equipment to the Tedlar® bag. Open Tedlar® bag valve by turning the Teflon® screw and pushing down on the stainless steel valve.

3.3.7. Purge system by filling and emptying the Tedlar® bag three times. Open cap to expel air. Do not fill bag to firmness at any time. This is done to prevent stress cracks from forming and destroying the Tedlar® bag.

3.3.8. Collect the sample by filling the Tedlar® bag being careful not to overfill.

3.3.9. Close valve on bag and remove bag from system. Label bag and log in the field report.

3.3.10. Allow the air sampling equipment pump to run between samples for a minimum of 2 minutes. Change tubing between different sampling areas, following known high samples, or when sampling in areas with unknown concentration ranges. It is not necessary to change the tubing in areas with

known low concentrations (less than 100 ppb) after each sample. In this case, tubing should be replaced after every 6 samples.

3.4. Highly contaminated sampling of vapor extraction wells and carbon drums.

These procedures will be followed when highly contaminated vapor samples (in the order of 10 ppm or greater) are suspected.

- 3.4.1. Use the vacuum desiccator to avoid contamination of the air sampling equipment.
- 3.4.2. Check local air quality surrounding sample collection point to ensure safe working conditions for field personnel.
- 3.4.3. Open vapor extraction well (VEW) sample valve or carbon sampling port as applicable. Next, take a reading with the portable VOC analyzer and record this value in the field report.
- 3.4.4. Connect the 3/16" ID x 3/8" OD Tygon® tubing to the sampling port. Next attach the tubing to the vacuum desiccator. Keep tube lengths as short as possible.
- 3.4.5. Attach 1/4" ID x 3/8" OD Tygon® tubing to the Tedlar® bag and the other end to the inside of the vacuum desiccator. Place the Tedlar® bag into the vacuum desiccator. Next, attach a length of 3/16" ID x 3/8" OD tubing, approximately 4" long, from the vacuum desiccator to the air sampling equipment intake.
- 3.4.6. Turn on the air sampling equipment. The air sampling equipment should be set to pump at a maximum rate.
- 3.4.7. Purge system by filling and emptying the Tedlar® bag three times. Do not fill bag to firmness at any time. This is done to prevent stress cracks from forming and destroying the Tedlar® bag. Every time the bag is filled you must open the vacuum desiccator, remove the Tedlar® bag and then empty the bag. Afterward, place the bag into the vacuum desiccator again and continue these steps until the system is purged.
- 3.4.8. Collect the sample by filling the Tedlar® bag, being careful not to overfill.
- 3.4.9. Close the valve on the Tedlar® bag and remove the bag from the desiccator. Label bag and log in the field report.

3.5. Sampling of pressurized discharges, blower discharge and carbon drums.

- 3.5.1. Check local air quality surrounding the sample collection point to ensure safe working conditions for field personnel.
- 3.5.2. Open the blower discharge port or the carbon sampling port whichever is applicable. Next, take a reading with the portable VOC analyzer and record this value in the field report.
- 3.5.3. Pressurized discharges can be sampled directly by connecting the Tedlar® bag directly to the sample valve with Tygon® tubing. Attach the Tedlar® bag to the sample valve using 3/16" ID x 3/8" OD Tygon® tubing.
- 3.5.4. Purge Tedlar® bag by filling and emptying three times. Do not fill bag to firmness at any time.
- 3.5.5. Next, collect the sample by filling the Tedlar® bag. Close the valve on the Tedlar® bag, label bag, and log in the field report.

4. **Quality Assurance/Quality Control**

4.1. Equipment blanks

- 4.1.1. Use new Tedlar® bags or used bags from which the previous sample results were analyzed as non-detect.
- 4.1.2. If sampling in an area of known high concentration, equipment blanks should be taken after every sample.
- 4.1.3. For all other areas, equipment blanks need to be taken at least every twenty samples or one per sampling event if less than twenty samples are collected.
- 4.1.4. Let the air sampling equipment purge for two or three minutes after collecting equipment blank.
- 4.1.5. The equipment blanks need to be collected using the same procedure and equipment setup as used when the samples were collected.

4.2. Collocated samples

- 4.2.1. A collocated sample needs to be collected at a frequency of one for every 20 samples or one per sampling event.

- 4.2.2. Sample according to Sections 3.1 through 3.5, using the appropriate section for where you are taking the duplicate sample.
- 4.2.3. For QA/QC purposes the Tedlar[®] bag containing the collocated sample should be assigned its own separate blind sample number.

5. Handling, Maintenance, and Storage

5.1. Maintenance

- 5.1.1. Let the pump run for a minimum of two minutes at the end of each sampling event.
- 5.1.2. Check the in line filter for contamination at least once a week or if any equipment blanks show contamination.
- 5.1.3. The batteries should be checked on a regular basis and need to be replaced when the pump does not run efficiently.

5.2. Handling and Storage

- 5.2.1. Samples need to be handled carefully since Tedlar[®] bags can be damaged quite easily.
- 5.2.2. The air sampling equipment and vacuum dessicator need to be put in their proper storage location after each use.
- 5.2.3. Any equipment deficiencies should be reported to the equipment manager.